Appendix G. Responses to Public Comments on White Oak Creek Radionuclide Releases Public Health Assessment

The Agency for Toxic Substances and Disease Registry (ATSDR) received the following comments from the public and local organizations during the public comment period (May 6, 2005 to June 23, 2005) for the White Oak Creek Radionuclide Releases at the Oak Ridge Reservation (ORR) Public Health Assessment (PHA) (April 2005). Public comments received on the initial release version of the document (dated December 2003) are indicated herein; all remaining comments respond to the April 2005 version of the document. For comments that questioned the validity of statements made in the PHA, ATSDR verified or corrected the statements.

	Comment	ATSDR's Response
General Comments		
1	ATSDR, an agency of the federal government, has a clear conflict of interest when it prepares health assessments on sites where the federal government itself is the primarily responsible party. This conflict is never clearer than today, when the federal government gives itself a high five for being such a good, clean citizen in Oak Ridge. Either ATSDR's methodology is suspect, or their knowledge base is suspect, or their honesty is suspect. In either case, the public is ill served by false assurances. The finding of the ATSDR that releases from the Oak Ridge National Laboratories over the past 60 years have posed no public health threat is unconscionable, unsupported by the scientific community, and flat-out false. The declaration that Oak Ridge has never posed a health risk cannot be supported by science or by common sense. ATSDR's finding is either the result of half-hearted work or simple duplicity.	In 1980, Congress established the ATSDR to carry out the health-related responsibilities under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) commonly known as the Superfund Law. CERCLA charges the EPA to find and to clean up the most dangerous hazardous waste sites in the United States, and CERCLA charges ATSDR to determine the extent of human exposure to hazardous substances at those sites. In 1984, ATSDR's public health authority was extended to Solid Waste Disposal Act (SWDA) sites. The Superfund Amendments and Reauthorization Act of 1986 further extended ATSDR's authority to federal facilities. ATSDR has the following legislation authorities that pertain to its activities at DOE sites: ■ Section 120 of CERCLA (42 USC 9620): concerns the application of CERCLA to federal facilities ■ Section 104(i) of CERCLA: concerns ATSDR's authorities and responsibilities ■ Section 107 of CERCLA: concerns liability ■ Section 3019 of SWDA (42 USC 6939a): concerns exposure information and health assessments As the lead public health agency responsible for implementing the health-related provisions of Superfund, ATSDR is charged with assessing health hazards at specific hazardous waste sites, helping to prevent or reduce exposure and the illnesses that result, and increasing knowledge and understanding of the health effects that may result from exposure to hazardous substances. As the potentially responsible party (PRP), DOE is required to fund cleanup and public health investigations, such as the ATSDR PHAs, for the Oak Ridge Reservation. ATSDR as an advisory, non-regulatory public health agency conducts independent public health assessments and provides recommended actions to protect public health. It makes health calls following an independent evaluation of data and exposure situations; it does not make any decisions based on who is funding its work.

	Comment	ATSDR's Response
		ATSDR's mission is to serve the public by using the best science, taking responsive public health actions and providing trusted health information to prevent harmful exposures and disease related to toxic substances. The ATSDR public health assessment process serves as a mechanism to help ATSDR scientists sort through the many hazards at waste sites and determine when, where, and for whom public health actions should be taken. Through this process, ATSDR finds out whether people living near or at a hazardous waste site are exposed to toxic substances, whether that exposure is harmful, and what must be done to stop or reduce an exposure. ATSDR scientists use the detailed guidance in the updated ATSDR *Public Health Assessment Guidance Manual* to identify hazards and to recommend needed public health actions. More information about the ATSDR evaluation process can be found in ATSDR's Public Health Assessment Guidance Manual at http://www.atsdr.cdc.gov/HAC/PHAManual/toc.html or by contacting ATSDR at 1-888-42-ATSDR. An interactive program that provides an overview of the process ATSDR uses to evaluate whether people will be harmed by hazardous materials is available at http://www.atsdr.cdc.gov/training/public-health-assessment-overview/html/index.html. This public health assessment evaluates the releases of radionuclides to the Clinch River and the Lower Watts Bar Reservoir from the ORR via White Oak Creek; assesses past, current, and future exposure to radionuclide releases for people who use or live along the Clinch River; and addresses the community health concerns and issues associated with the radionuclide releases from White Oak Creek. ATSDR evaluated data and exposure situations to determine the public health implications of past, current, and future off-site exposures. ATSDR concluded that past, current, and future exposures to radionuclides released from White Oak Creek to the Clinch River and Lower Watts Bar Reservoir are not a public health hazard. Though people might have or might yet come in contact with X-10 radionuclides that entered the Clinch River or Lower Watts Bar Reservoir via White Oak Creek, ATSDR's evaluation of data and exposure situations for users of these waterways indicates that the levels of radionuclides in the sediment, surface water, and biota are—and have been in the past—too low to cause observable health effects. That said, however, please note that ATSDR never states nor implies in this PHA that, "…releases from the Oak Ridge National Laboratories over the past 60 years have posed no public health threat…" This PHA only evaluates off-site exposures to X-10 radionuclides released to White Oak Creek that entered the Clinch River and Lower Watts Bar Reservoir. The PHA does not evaluate any on-site exposures (these are handled by other agencies) or exposures to other contaminants released from this facility. In addition to this PHA, ATSDR

	Comment	ATSDR's Response
		is also conducting public health assessments on X-10 iodine 131 releases, Y-12 mercury releases, K-25 uranium and fluoride releases, PCB releases from X-10, Y-12, and K-25, and other topics such as the Toxic Substances Control Act (TSCA) incinerator and off-site groundwater. For copies of these other assessments, please contact ATSDR's Information Center toll-free at 1-888-422-8737.
2	It never ceases to amaze me how our government officials like to pronounce threats as totally harmless. Over the years it has been contaminated geese and frogs, air and water, yet the threat is always stated to be so innocuous that the animals or fish could be eaten, yet millions of dollars are being spent to clean it up and dispose of it. Is it me or is there a real large logic gap here? What is wrong with this picture? If White Oak Creek Drainage Basin poses absolutely no threat, as the Agency for Toxic Substances and Disease Registry states, why are so many millions being spent to clean up and remediate the area by the Department of Energy? How can we find credibility amid the illogic of such duplicity? Either there is a real threat here, even though it may be fairly minor — a few deaths per 100,000 — or a lot of money is being poured into the waste heap. This certainly seems to be the case with money for the agency efforts that are obviously purely palliatives without a shred of credibility. It is time for real mortality-morbidity data to be placed on the table — no more empty pronouncements of complete safety. Only an idiot sees the world in such black-and-white contrast.	It is true that DOE has spent and continues to spend billions of dollars on environmental remediation at the Oak Ridge Reservation. As a result of past activities at the ORR, parts of the on-site facilities and lands have been contaminated with PCBs, radioactive elements, asbestos, mercury, and other industrial wastes. In November 1989, EPA listed the ORR on the final National Priorities List (NPL). DOE is performing remediation activities at the reservation under a Federal Facility Agreement (FFA), which is an interagency agreement between the DOE, EPA, and TDEC. EPA and TDEC, and the public help DOE select the details for remedial actions at the ORR. These stakeholders work collaboratively to ensure the remediation activities are adequate, and to ensure that hazardous waste related to previous and current ORR activities is completely studied and appropriate remedial action is taken. Environmental management is the largest program at Oak Ridge. Information on the program is available at http://www.oakridge.doe.gov/External/Default.aspx?tabid=42. Though DOE is remediating these wastes, it is extremely important to understand that the federal funding used to remediate these lands and facilities are only for contamination within the reservation—none of the funding is intended for clean up of off-site areas; the on-site areas currently undergoing remediation are not accessible to residents. Though costly, DOE is spending this money to prevent contamination from traveling off site, or at a minimum, to detect it in a timely manner before it affects off-site areas. ATSDR's PHAs are evaluations of exposures to off-site populations. This PHA evaluates the releases of radionuclides to the Clinch River and the Lower Watts Bar Reservoir from the X-10 site via White Oak Creek; assesses past, current, and future exposure to radionuclide releases for people who use or live along the Clinch River from the Melton Hill Dam to the Watts Bar Dam; and addresses the community health concerns and issues associated with the radionuclide releases from White Oak Creek. It is not an evaluation of people who were exposed while working on-site at the reservation. Other agencies handle that responsibility. ATSDR concluded that past, current, and future exposures to radionuclides released from White Oak Creek to the Clinch River and the Lower Watts Bar Reservoir are not a public health hazard. People who used or lived along the Clinch River or Lower Watts Bar Reservoir in the past, or who currently do so or will in the future, might have or might yet come in contact with X-10 radionuclides that entered the Clinch River or Lower Watts Bar

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		Reservoir via White Oak Creek. ATSDR's evaluation of data and exposure situations for users of these waterways indicates, however, that the levels of radionuclides in the sediment, surface water, and biota are—and have been in the past—too low to cause observable health effects.
3	There is a need for an independent external peer review of this ATSDR PHA (from scientists who have not been selected by the ATSDR) to address issues of technical and public credibility. These reviewers should have independence from DOE and its contractors. They should also be free from local organizational and economic conflicts of interest. He expressed concern that the data validation process and internal ATSDR review did not catch what he considered to be discrepancies. In his opinion, this report contained major technical errors that had implications in terms of how ATSDR conducts business. In the past, CDC/NCEH relied on a standing committee of the NRC/NAS for peer reviews of CDC contractor dose reconstructions and risk evaluations. Such peer reviews by the NRC/NAS were conducted at Hanford, Fernald, INEL, and Savannah River. I recommend that consideration be given to the reactivation of this committee of the NRC/NAS for scientific peer review of the technical content of the ATSDR PHAs at Oak Ridge. In addition, such a peer review should address whether or not these PHAs have been responsive to community concerns.	The White Oak Creek Radionuclide Releases PHA underwent an internal ATSDR review, a data validation review by other government agencies (i.e., the Department of Energy and the Tennessee Department of Environment and Conservation), and an external review. Through its external peer review process, ATSDR's Office of Science had three scientific experts review this public health assessment (see Appendix H for the peer reviewer comments and ATSDR's responses). The agency's peer review process provides an objective and thorough evaluation of this PHA by experts in the fields this assessment covers—specifically, health physics. Individuals within the agency who have the proper background (e.g., toxicology and health physics) also reviewed the document during the agency's internal review process. During the external review process, scientists not employed by ATSDR or the CDC independently reviewed this document and provided us with their unbiased, scientific opinions. All peer reviewers approved of the assessment and found no major flaws that would invalidate ATSDR's conclusions and recommendations. In the words of one peer reviewer: "You [ATSDR] have done a good job under very difficult circumstances with a lot of unwanted publicity and carping. The science under the report is very good and the report is well written in a very good manner that is suitable for both an informed and interested public and the scientific community." Further, an external peer reviewer commented, "The study further addresses local concerns raised by the residents of the area even when it is doubtful that there is any validity to the concern raised."
4	Clearly define what is meant by a "public health hazard." Clearly distinguish between the ability to observe health effects and the potential existence of health effects that cannot be detected at low doses. The inability to detect effects does not mean zero risk of radiation exposure, as is implied at several points in the current draft.	Public health hazard is now defined in the summary of the final PHA on page 2 as "a source of potential harm to human health as a result of past, current, or future exposures." ATSDR recognizes that every radiation dose, action, or activity may have an associated risk. Given our evaluation in this public health assessment, ATSDR concludes that exposures to X-10 radionuclides released from White Oak Creek to the Clinch River and to the Lower Watts Bar Reservoir are not a health hazard. Past and current exposures are below levels associated with adverse health effects and regulatory limits. Adults or children who have used, or who might continue to use, the waterways for recreation, food, or drinking water are not expected to have adverse health effects due to exposure. ATSDR has categorized those situations as posing *no apparent public health hazard* from exposure to radionuclides related to X-10. This classification means that people could be or were

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		exposed, but that the level of exposure would not likely result in any adverse health effects. Contrary to this commenter's statement, the document does not imply that the inability to detect effects means no risk of exposure. This is clearly evident by the use of the *no apparent public health hazard* conclusion category in this public health assessment. ATSDR uses this category in situations in which human exposure to contaminated media might be occurring, might have occurred in the past, or might occur in the future, but where the exposure is not expected to cause any harmful health effects. Therefore, it is evident that ATSDR is not saying there is no risk of radiation exposure. On the contrary, we are saying that radiation exposure is possible, but that this exposure is not expected to result in observable health effects. EPA-conducted risk assessments are useful in determining safe regulatory limits and in prioritizing sites for cleanup. These risk assessments provide estimates of theoretical risk from possible current or future exposures and consider all contaminated media regardless of whether exposures are occurring or are likely to occur. These quantitative risk estimates are not intended, however, to predict the incidence of disease or to measure the actual health effects in people caused by hazardous substances at a site. By design, these risk estimates are conservative predictions that generally overestimate risk. Risk assessments do not provide a perspective on what the risk estimates mean in the context of the site community and do not measure the actual health effects that hazardous substances have on people. ATSDR uses the public health assessment process to evaluate the public health implications of exposure to environmental contamination and to identify the appropriate public health actions for particular communities. ATSDR scientists conduct a health effects evaluation by carefully examining site-specific exposure conditions about actual or likely exposures; conducting a critical review of available toxicological, medical, and epidemiologic information to ascertain the substance-specific toxicity characteristics (i.e., levels of significant human exposure), and comparing an estimate of the amount of chemical exposure (i.e., dose) to which people might frequently encounter at a site to situations that have been associated with disease and injury. This health effects evaluation involves a balanced review and integration of site-related environmental data, site-specific exposure factors, and toxicological, radiological, epidemiologic, medical, and health outcome data to help determine whether exposure to contaminant levels might result in harmful effects. The goal of the health effects evaluation is to decide whether harmful effects might be possible in the exposed population by weighing the scientific evidence and by keeping site-specific doses in perspective. The output is a qualitative description of whether site exposure doses are of sufficient nature and magnitude to trigger a public health action to limit or eliminate, or to study further any potentially harmful exposures. The

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		PHA presents conclusions about the actual existence and level of the health threat (if any) posed by a site. It also recommends ways to stop or reduce exposures. For detailed information on risk, please see Appendix F in the final PHA.
5	There are a lot of concerned individuals downwind and downstream of the Department of Energy Oak Ridge Reservation (DOE ORR). (*Comment received on the initial release PHA dated December 2003.)*	Thank you for your comment. Section VI. Community Health Concerns of the final PHA contains the public health concerns received from area residents, community groups, and other interested parties related to issues associated with radionuclide releases from White Oak Creek, as well as ATSDR's responses to these concerns. These concerns and responses are sorted by category (X-10 facility processes and exposure pathway concerns, concerns about radionuclides associated with X-10's releases to White Oak Creek, concerns about contaminants released from the Oak Ridge Reservation, and general concerns related to the Oak Ridge Reservation) and presented in tabular form in Section VI of the final PHA. Also, ATSDR developed a *Community Health Concerns Database* to compile and track community health concerns related to the ORR. From 2001 to 2005, ATSDR compiled more than 3,000 community health concerns obtained from the ATSDR/ORRHES community health concerns comment sheets, written correspondence, telephone calls, newspapers, comments made at public meetings (e.g., ORRHES and work group meetings), and surveys conducted by other agencies and organizations. Further, within this section of the final PHA ATSDR provides responses to the comments received on the public comment version of the White Oak Creek Radionuclide Releases PHA. During the PHA's external peer review process, a peer reviewer made the following comment regarding this issue: "The study further addresses local concerns raised by the residents of the area even when it is doubtful that there is any validity to the concern raised." Thus, as this reviewer points out, ATSDR is addressing all of the community concerns related to releases from X-10 to White Oak Creek.
6	According to the Final Report of the Oak Ridge Health Agreement Steering Panel titled: Releases of Contaminants from Oak Ridge Facilities and Risks to Public Health, December, 1999, ATSDR has not even scratched the surface of the bewildering array of public health concerns of the many communities downwind and downstream of DOE ORR. (*Comment received on the initial release PHA dated December 2003.)*	After reviewing the ORHASP report, it is unclear what concerns have not been addressed. ATSDR has reviewed this report and has an entire section (Section VI. Community Health Concerns) of the final PHA devoted to listing and addressing community concerns received about X-10 radionuclide releases to the Clinch River and the Lower Watts Bar Reservoir via White Oak Creek. In fact, from 1991 to 2000 ATSDR completed the following public health activities to address specific ***current*** off-site public health concerns and issues not addressed by the Tennessee Department of Health's Oak Ridge Health Studies. These studies only evaluated whether off-site populations experienced ***past*** exposures to radiological and

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		chemical releases from the ORR. *Review of Clinical Information on Persons Living in or near Oak Ridge, Tennessee* dated September 10, 1992. *Health Consultation on Y-12 Weapon Plant Chemical Releases into East Fork Poplar Creek* dated April 5, 1993. DOE implemented many of ATSDR's recommendations before finalizing the Remedial Investigation and Feasibility Study on Lower East Fork Poplar Creek and the 1995 Record of Decision for the Lower East Fork Poplar Creek. *Clinical Laboratory Support* in 1994. ATSDR and the National Center for Environmental Health (NCEH) facilitated clinical laboratory support by the NCEH Environmental Health Laboratory for patients referred to the Emory University School of Public Health by an Oak Ridge physician. *ATSDR Science Panel on the Bioavailability of Inorganic Mercury* in August 1995. Four papers were published by science panel members in *Risk Analysis*.17 (5), 527-569 (1996). *Health Consultation on DOE's Proposed Mercury Clean-up Level for the East Fork Poplar Creek Floodplain Soil* dated January 1996. DOE cited the conclusions of this health consultation in the 1995 Record of Decision for the Lower East Fork Poplar Creek. *Health Consultation on Lower Watts Bar Reservoir* dated February 1996. DOE cited this health consultation in the 1995 Record of Decision for the Lower Watts Bar Reservoir. The state of Tennessee followed up on the recommendation to analyze for PCBs in turtles. *Physician Health Education Program on Cyanide* in August 1996. The physician education program supplied health care providers with information on health impacts of possible cyanide intoxication. *Community and Physician Education on PCBs in Fish* in September 1996. ATSDR developed a community and physician education program on PCBs in Watts Bar Reservoir fish to follow up on recommendations contained in the ATSDR health consultation. *Watts Bar Reservoir Fish Advisory Pointers* brochure dated 1997. ATSDR worked with the state of Tennessee and local community groups to develop the brochure as a follow up on recommendations contained in the ATSDR health consultation. *Exposure Investigation on Serum PCB and Blood Mercury Levels in Consumers of Fish and Turtles from Watts Bar Reservoir* dated March 1998. This exposure investigation is a follow-up activity to the ATSDR Health Consultation on Lower Watts Bar Reservoir dated February 1996 and to respond specifically to an informal recommendation from the Oak Ridge Health Agreement Steering Panel, as well as respond to general community interest. This study

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		was done to measure actual PCB and mercury levels in people who have eaten large amounts of Watts Bar Reservoir fish or turtles. ATSDR tested for PCBs because previous investigations estimated that people who eat certain fish or turtles might have higher than average levels of PCBs in their bodies and suggested that the levels of PCBs in fish were a public health concern. ATSDR tested the blood samples for mercury because mercury was a historic contaminant of concern. Recent studies, however, have not detected mercury at levels of health concern in surface water, sediments, or fish from the Watts Bar Reservoir. *Compendium of Public Health Activities at the U.S. Department of Energy Oak Ridge Reservation* (updated version) dated November 2000. ATSDR initiated and coordinated the development of the compendium to outline the past and present strategies used to address and evaluate public health issues related to chemical and radioactive substances released from the Oak Ridge Reservation. Copies of ATSDR documents are available on ATSDR's Oak Ridge Reservation Public Health Web site at http://www.atsdr.cdc.gov/HAC/oakridge/index.html. In addition, detailed summaries of the public health activities prior to 2000 are available in the *Compendium of Public Health Activities at the U.S. Department of Energy* dated November 2000 on the ATSDR's Oak Ridge Reservation Public Health Web site at http://www.atsdr.cdc.gov/HAC/oakridge/phact/c_toc.html. In 2001, ATSDR scientists conducted a review and analysis of the Phase I and Phase II screening evaluations of the Tennessee Department of Health's Oak Ridge Health Studies to identify contaminants that required further public health evaluation. ATSDR staff presented this review and analysis of the Phase I and Phase II screening evaluations to the Oak Ridge Reservation Health Effects Subcommittee (ORRHES). Given ATSDR's review and the comments received from the ORRHES, ATSDR scientists decided to use the ATSDR public health assessment process to conduct chemical-specific and issue-specific public health assessments and to address issues and community health concerns related to the following: ■ Past and current exposure to uranium released from the Y-12 Weapons Plant, ■ Exposure to contaminants released from the Toxic Substances Control Act (TSCA) incinerator, ■ Past and current exposure to radionuclides released from White Oak Creek, ■ Exposure to contaminated off-site groundwater, ■ Past exposure to radioactive iodine (I 131) released from X-10, ■ Past and current exposure to mercury released from the Y-12 Weapons Plant, ■ Past and current exposure to uranium and fluoride released from K-25, ■ Past and current exposure to PCBs released from X-10, Y-12, and K-25

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		■ Current (1990-2003) and future exposure to other chemicals near the reservation, and ■ Overall summary on the screening process and exposures to a mixture of chemicals and radionuclides. At the February 11, 2002 ORRHES meeting, the ORRHES approved a recommendation endorsing ATSDR's screening process to determine the list of contaminants for further evaluation using the ATSDR public health assessment process.
Evaluation of Additional Populations		
7	Pp. i. Line 34, and ii. Line 5. Given the emphasis placed on consideration of children, it would be appropriate to add pregnant and lactating women to the list of high risk groups. This will cover the fetus and the breast-fed infant. It's also a nice thing to do for women of childbearing age given the potential adverse impact of radiation exposure on their reproductive experience.	The section referenced by the commenter is ATSDR's standard forward used in all public health assessments. This particular group is not being added to our standard forward because it is particular to this evaluation and not necessarily appropriate for all public health assessments. But a discussion of this group has been added to Section VII. Child Health Considerations in the final PHA.
8	Page 105, Line 29. Stakeholders believe that ATSDR is not taking into consideration subsistence fishers who will consume much more than the standard "reference man" that ATSDR is utilizing. Stakeholders believe that ATSDR is 'blowing off' the more significant hazard that these fish present to growing children and pregnant women by ingestion of fish. Of special concern is ingestion of fish contaminated with Sr-90 and Cs-137. These three exposure considerations were, in fact, the most important 'risk drivers' of exposure to the consumption of radioactively contaminated fish downstream from another DOE facility, the Savannah River Site, near Aiken, SC. (*Comment received on the initial release PHA dated December 2003.)*	To evaluate past, current, and future exposures to radionuclides in Clinch River and Lower Watts Bar Reservoir fish, average fish consumers were evaluated (detailed below). In its Exposure Factors Handbook (available at http://www.epa.gov/ncea/pdfs/efh/front.pdf) that outlines factors commonly used in exposure assessments EPA recommends using an assumed average intake rate for fish consumption for the general population of 20.1 grams/day (140.7 grams/week) of total fish. Of this fish intake rate, however, only 6.0 grams/day (42 grams/week) is considered as an average intake rate for the general population consuming freshwater and estuarine fish. All of the exposure assumptions used by ATSDR for past, current, and future exposures to radionuclides in Clinch River and Lower Watts Bar Reservoir fish were at least five times **more than** this average intake for the general population eating freshwater and estuarine fish. As detailed below, even when evaluating fish consumption by using assumed intake rates significantly above these recommended assumptions, ATSDR's estimated doses for past, current, and future exposures were below health-based comparison values. In the Task 4 of the Tennessee Department of Health's Reports of the Oak Ridge Dose Reconstruction (Task 4 report), past exposures to radionuclides in Clinch River fish were evaluated for high fish consumers. Reportedly, a maximum fish consumer in the east south central region of the country would eat about 2.4 fish meals per week (based on a 200 gram per meal fish portion) (Rupp et al. 1980. Age dependent values of dietary intake for assessing human exposures to environmental pollutants. Health Physics 39: 151-163. Cited in the Task 4 report). The Task 4 report evaluated high fish consumers, who were referred to as "Category I fish consumers" and were described as individuals who frequently

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		(between 1 and 2.5 fish meals per week) ate fish. To evaluate past exposure to radionuclides in the Clinch River, ATSDR summarized the Task 4 organ doses from the Task 4 report for the bone, lower large intestine, red bone marrow, breast, and skin locations using the 50th percentile value of the uncertainty distribution. The 50th percentile (central) values represent the medians of organ doses. The highest radiation doses were associated with eating fish taken from the Clinch River near Jones Island between 1944 and 1991. Doses were much lower for all other pathways (see Table 11 and Table 12 in the final PHA). The Task 4 report's estimated organ doses to the bone, lower large intestine, red bone marrow, breast, and skin from eating fish were at least six times greater than the radiation doses to these organs from ingesting meat and milk, drinking water, and external radiation (see Table 12 in the final PHA). Likewise, ATSDR's derived annual whole-body and committed equivalent doses from eating fish were at least 10 times more than any of the other exposure pathways (see Table 11 in the final PHA). As mentioned and shown in Table 11, radiation doses from eating fish were highest near Jones Island—these annual whole-body and lifetime (70-year) doses were more than eight times greater than for people consuming fish from the Clinch River further downstream near Kingston. The annual whole-body dose was less than 3.4 mrem/year for an individual ingesting fish near Jones Island more than 29 times less than the 100 mrem/year recommended dose limit for the public by the International Commission on Radiological Protection (ICRP), the U.S. Nuclear Regulatory Commission (NRC), and the National Council on Radiation Protection and Measurements (NCRP). The whole-body lifetime dose for an individual ingesting fish caught near Jones Island was 238.6 mrem over 70 years more than 20 times less than ATSDR's radiogenic cancer comparison value of 5,000 mrem over 70 years. To evaluate current and future exposure to radionuclides in Lower Watts Bar Reservoir fish, this public health assessment used data from ATSDR's Health Consultation on the Lower Watts Bar Reservoir. The health consultation used worst-case scenarios to evaluate radiological exposure to fish, assuming adults and children consumed two 8-ounce fish meals per week (454 grams/week), which is 10 times the intake rate (42 grams/week) recommended by EPA for freshwater fish. Even using these conservative exposure assumptions, the estimated dose was 6 mrem per year or less than 420 mrem over 70 years for the committed effective dose. The annual whole-body dose of 6 mrem per year is more than 16 times less than the dose of 100 mrem/year recommended for the public by the NCRP, ICRP, and NRC. The committed effective dose of 420 mrem over 70 years is more than 11 times less than ATSDR's radiogenic cancer comparison value of 5,000 mrem over 70 years. To evaluate current and future exposure to radionuclides in Clinch River fish, ATSDR

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		assumed a child ate 4 ounces of fish per week (113.4 grams/week) and an adult ate 8 ounces of fish per week (227 grams/week). This fish intake rate is based on a survey of high to moderate fish consumers during the ATSDR *Exposure Investigation on Serum PCB and Blood Mercury Levels in Consumers of Fish and Turtles from Watts Bar Reservoir* dated March 1998. Based on this intake rate, the highest estimated whole-body dose of 89.3 mrem—calculated for a 20-year-old adult exposed over 50 years (to age 70)—is 55 times less than ATSDR's radiogenic cancer comparison value of 5,000 mrem over 70 years. Further, the PHA evaluates childhood exposures within Section III. Evaluation of Environmental Contamination and Potential Exposure Pathways and in Section VII. Child Health Considerations of the final PHA. In addition, a discussion of pregnant women has been added to Section VII of the final document.
9	Page 124, Line 1. ATSDR has omitted the risk to unborn children sustained by their mothers consuming fish contaminated with radioactive cesium, strontium, and other radionuclides. This is especially important because there has never been a Tennessee fish advisory in place in any of these downstream communities to warn the public of the imminent and substantial hazard posed by consuming 'hot fish' downstream of DOE ORR. The only warning is the PCBs – radioactive contamination is never even mentioned once on any of the stream signage or in any of Tennessee's official fish advisories. (*Comment received on the initial release PHA dated December 2003.)*	A discussion of exposure *in utero* has been added to Section VII. Child Health Considerations in the final PHA. In the Task 4 of the Tennessee Department of Health's Reports of the Oak Ridge Dose Reconstruction (Task 4 report), the Task 4 team concluded that its estimated radiological doses and excess lifetime cancer risks were "incremental increases above those resulting from exposure to natural and other anthropogenic sources of radiation," but were "not large enough for a commensurate increase in health effects in the population to be detectable, even by the most thorough of epidemiological investigations." The Task 4 team noted that "in most cases, the estimated organ-specific doses are clearly below the limits of epidemiological detection (1 to 30 cSv [centisievert]) for radiation-induced health outcomes that have been observed following irradiation of large cohorts of individuals exposed either in utero (Doll and Wakeford 1997), as children, or as adults (NRC 1990; Thompson et al. 1994; Pierce et al. 1996)" (ChemRisk 1999a). Thus, because past radiation exposures—when doses were the highest—were not expected to cause harmful health effects *in utero*, in infants, and in children, adverse health effects would also not be expected to occur as a result of current and future radiation exposures to the Clinch River and Lower Watts Bar Reservoir. White Oak Creek radionuclide releases and contaminant concentrations have continued to decrease over time. Regarding the fish advisories, the Tennessee Department of Environment and Conservation's (TDEC) Division of Water Control is responsible for issuing and posting fish advisories. Evaluating fish tissue problems in the state of Tennessee involves a multi-agency effort, comprised of DOE, EPA, TDEC, the Tennessee Wildlife Resources Agency (TWRA), and the Tennessee Valley Authority (TVA). An abundance of data are available on contaminants in fish in these systems, including data collected by TVA, DOE, TWRA, and TDEC. These agencies use Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) criteria to analyze fish tissue in these waterways, which applies EPA

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		risk assessment to evaluating potential exposures to contaminants in fish. DOE, TDEC, and EPA have responsibilities under CERCLA, but the state has ultimate responsibility for the advisories. The state fish advisories are available at http://www.state.tn.us/twra/fish/contaminants.html. It is important to understand that although radionuclides and other contaminants might be present in fish in the Clinch River and the Lower Watts Bar Reservoir, **only PCBs** have been found at levels in particular species of fish that could potentially cause adverse health effects. This is why radionuclides are not part of the advisories for these waterways—they have not been detected at harmful levels in these water systems. These agencies are basing their advisories on numerous data collected over several years by different entities, all of which show that radionuclides are not present in fish in the Lower Watts Bar Reservoir and the Clinch River at levels that could cause adverse health effects. ATSDR's evaluation in this public health assessment concurs with the findings of the state, EPA, and these other entities. In addition, ATSDR is preparing a public health assessment that will evaluate PCB releases from the three main ORR facilities: X-10, Y-12, and K-25. When available, copies of ATSDR's public health assessment on PCBs can be obtained by contacting ATSDR's Information Center toll-free at 1-888-422-8737.
Evaluation of Past Exposures		
10	Page 4, lines 18–20: ATSDR should provide the rationale for the conclusion that "Because of conservative parameters used by the Task 4 team, the calculated risk and true exposure would not be underestimated for people who actually lived in the community." As currently presented, this is an opinion that is not supported either by the analysis of the Task 4 report in Sect. III.B or by the summary in Appendix D. It is an important conclusion that deserves to be fully documented.	The comment is noted. To align the text more with the statements in the Task 4 of the Tennessee Department of Health's Reports of the Oak Ridge Dose Reconstruction (Task 4 report), this text was changed to the following in the final PHA: "The Task 4 team used conservative screening parameters with the intention of calculating estimates of risk that are not likely to underestimate the actual risk to any exposed individual. Meaning, for each radionuclide and exposure pathway evaluated, the Task 4 team expected these calculated estimates to overestimate the risk for most or all real individuals."
11	There are several problems with the analysis, the first of which is that ATSDR ignored doses to organs/tissues other than bone surface, lower large intestine, red bone marrow, the female breast, and skin in calculating the effective dose (their whole-body dose). ATSDR's approach to dose estimation was seriously flawed because it ignored dose contributions to organs and tissues other than those currently listed in Table 11. Thus, until those flaws are corrected, the above comments, which were based on the erroneous (incomplete) sets of doses, are superfluous.	The effective dose is the sum of the dose received by all organs of the body. The equivalent dose is the dose received by specific organs. This approach varied in the public health assessment depending on the specific radionuclides being evaluated. See Section III. Evaluation of Environmental Contamination and Potential Exposure Pathways in the final PHA for more specific information on this evaluation. ATSDR uses the critical organ concept. The critical organ, as defined by the International Commission on Radiological Protection (ICRP), is the organ receiving the highest radiation dose following an intake of radioactive material. Basically, the critical organ is the organ or organ system most susceptible to radiation damage resulting from the specific exposure conditions being evaluated. This concept also takes into account the dose received by

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		various parts of the body under these exposure conditions. For its public health evaluation of past exposures (those referenced by the commenter), ATSDR considered the contaminants of concern for X-10 radionuclide releases to White Oak Creek and chose the organ systems based on this critical organ concept. For the dose assessment, ATSDR looked at the following critical organs: bone, lower large intestine, red bone marrow, breast, and skin. For example, cesium 137 is a whole-body issue. It is distributed fairly uniformly throughout the body, with the intestines receiving the highest radiation dose. Strontium 90, however, is considered a bone-seeking radionuclide because while about 70-80% of the amount of ingested strontium 90 passes through the body, nearly all of the remaining 20–30% of strontium 90 is absorbed and deposited in the bone.
	They simply divide this value by 48 (number of years of exposure) to estimate an annual average dose to the whole body. Their approach yielded an annual average dose to the whole body of ~4 mrem/year (which is based primarily on the doses to a Category I fish eater who consumed fish caught near Jones Island). They then compare this value with the "100-mrem per year dose recommended for the public" by ATSDR, the ICRP, the NRC, and the NCRP, and reach the obvious conclusion that this annual dose is small in comparison to the recommended dose (limit).	The method described by the commenter is used as a first approximation of the annual dose. This method is generally used by many agencies, including the U.S. Environmental Protection Agency (EPA), the U.S. Department of Energy (DOE), and the U.S. Nuclear Regulatory Commission (NRC) in determining the accumulated dose in the first year following an intake. This issue was discussed at several Exposure Evaluation Work Group meetings (EEWG, formerly known as the Public Health Assessment Work Group [PHAWG]) and at the Oak Ridge Reservation Health Effects Subcommittee (ORRHES) meetings where the screening process was discussed. The reason for dividing the total dose by 48 years (for certain exposure scenarios, ATSDR divided the total dose by a different number of years; see Table 10 in the final PHA for these specific scenarios) was to establish a first approximation of the dose, as this would allow for comparison to the 100 mrem/year dose limit recommended for the public by the ICRP, the National Council on Radiation Protection and Measurements (NCRP), the NRC, and ATSDR. ATSDR approximated the annual whole-body dose for each pathway by applying weighting factors to the Task 4's estimated 50th percentile organ-specific doses, adjusting for a 1-year exposure, and summing the adjusted organ doses across each pathway. The first approximation value of 4.0-mrem/year for past exposures is 25 times less than the 100 mrem/year dose limit recommended for the public. Because this approximated value is so much lower than the dose limit recommended for the public during the screening-level evaluation, no further actions were necessary. Had the approximation shown an annual dose close to 100 mrem/year, ATSDR would have re-assessed the evaluation and conducted further investigation.
	However, doses for an essentially complete suite of organs/tissues were provided in Appendix 13A in the Task 4 report. When a complete accounting of organ/tissue doses is made using 50th percentile estimates in conjunction with the tissue weighting factors given in Table 6 of the PHA, the average annual dose to male and female Category I fish eaters over the 1944–1991 exposure period increases to 9.4 mrem/year and 6.4	Yes, this is correct. Even when using different calculations and including all organs and tissues evaluated in the Task 4 of the Tennessee Department of Health's Reports of the Oak Ridge Dose Reconstruction (Task 4 report) to estimate doses for the worst-case exposure scenario (i.e., a Category I fish consumer near Jones Island), the annual doses would still be more than 10 times less than 100 mrem/year—the radiation dose limit recommended for the public by the NCRP, NRC, and ICRP. Thus, even when different

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	mrem/year, respectively, or, on average, about twice what ATSDR calculated.	calculations are applied, the commenter still calculated an estimated dose significantly below the 100 mrem/year recommended dose limit.
12	Page 5, paragraph 3: The authors focus exclusively on 50th percentile estimates of "whole-body doses" and derived annual average dose, while their analysis of the Task 4 report in Sect. III.B covers critical, but incomplete, information on a suite of doses to individual organs/tissues. Furthermore, the summation of 50th percentiles as point estimates will underestimate the median value for the total dose and risk. The ATSDR PHA uses statistically inappropriate procedures for dose summation of annual doses. The original Task 4 report produced 95% credibility intervals for all dose and risk estimates. The central value of these intervals was the median, 50th percentile of the underlying probability distribution or obtained from a quantitative uncertainty analysis. Using median values as point values to sum each annual dose to produce a lifetime cumulative dose will underestimate the median value of the cumulative dose. When estimating risk for individuals exposed to radiation, the full credibility interval of dose is more scientifically appropriate than the central value. The arithmetic mean of that distribution is more appropriate than the median value for estimating the average dose and risk to a group of exposed individuals. The mean value of risk is the summarization of the full weight of evidence that cancer could be induced due to exposure. There is the potential for substantial underestimation of annual doses and cumulative lifetime effective whole body doses to maximally exposed persons. This issue is exacerbated by ignoring 95% credibility intervals on the dose estimates reported in the original Task 4 report and by failure to sum across all of the organs irradiated through ingestion of Cs-137. For most organs, the dose is the result of ingestion of Cs-137. Thus, the whole-body dose and the organ-specific doses are nearly identical. There is some additional dose to the bone and red bone marrow contributed by ingestion of Sr-90 and to the gastrointestinal tract from ingestion of Ru-106. It is the range of doses (represented by the 95% credibility intervals provided in the Task 4 report) that should have been used in the ATSDR analysis. A value based solely on a 50th percentile estimate is an	Contrary to this commenter's opinion, using the full estimated interval of the dose is not more scientifically appropriate than the 50th percentile estimate when evaluating health effects from exposure. Instead, use of the full interval of the dose or the central estimates depends on the realistic, site-specific exposure conditions about the actual or likely exposures evaluated. Further, use of the upper-bound value artificially increases the risk: the calculated uncertainty in many cases is at least an order of magnitude or greater than the 50th percentile value. In this public health assessment ATSDR uses the central values because they provide the most realistic doses for potential exposures to radionuclides in the Clinch River and the Lower Watts Bar Reservoir. Central estimates describe the risk or dose for a typical, realistic individual. The goal of the health effects evaluation is to decide whether harmful health effects might be possible in the exposed population by weighing the scientific evidence and by keeping the site-specific doses in perspective. When considering central estimates, half of the potential doses will fall above and half will fall below the estimate. Therefore, an individual's actual dose would be most likely closer to the central value than near the high or low end of the dose estimate range. In fact, ATSDR's external reviewers who evaluated documents associated with the Oak Ridge Dose Reconstruction recommended emphasizing the central estimate rather than the upper and lower bounds of the dose distribution. For its evaluation of past exposures to X-10 radionuclide releases via White Oak Creek, ATSDR used a dose methodology and considered the 50th percentile estimates provided in the Task 4 report (available at http://www2.state.tn.us/health/CEDS/OakRidge/WOak1.pdf). The Task 4 team, on the other hand, used a risk model and the upper 95th percentile dose and risk levels. Nonetheless, even using different approaches, ATSDR came to the same basic conclusions as described below. According to page 15-2 of the Task 4 report, "The highest exposures, doses, and estimated lifetime risks of excess cancer incidence were from the ingestion of contaminated fish. The most highly contaminated fish would have been harvested in the vicinity of CRM [Clinch River Mile] 20.5, near Jones Island." Further, according to page 13-18 of the Task 4 report, "For the Jones Island area (CRM 20.5), the large total risk from ingestion of fish for the Category I consumer is considered by the study team to be a conservative estimate, because the likelihood is small that someone consumed that mush fish from only the Jones Island area." On page 15-4 of the Task 4 report, the authors' state: that "The radiological doses and excess lifetime cancer risks estimated in this report are incremental increases above those resulting from exposure to natural and other anthropogenic sources of

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	insufficient estimator of true dose and subsequent risks. When the average annual effective doses are derived using the 95th percentile estimates of doses over the 48-year exposure period, the values for both male and female Category I fish consumers fall in the 75–80 mrem/year range (or ~4 rem/40 mSv over 48 years). Although the average annual doses for female fish consumers based on the 50th percentile dose estimates are lower than those for males, the ratios of the 95th to the 50th percentile significantly higher for females (cf. values in Table 13.A.1 and 13.A.4 in the Appendices to the Task 4 report). These 95th percentile dose estimates are fairly close to the annual 100-mrem dose (limit) used as a Minimum Risk Level "Comparison Value" by the ATSDR.	radiation. Nevertheless, for the exposure pathways considered in this task, the doses and risks are not large enough for a commensurate increase in health effects in the population to be detectable, even by the most thorough of epidemiological investigations. In most cases, the estimated organ-specific doses are clearly below the limits of epidemiological detection (1 to 30 cSv [centisievert]) for radiation-induced health outcomes that have been observed following irradiation of large cohorts of individuals exposed either in utero, as children, or as adults." "Even in the case of Category I consumers of fish, the upper confidence limits on the estimated organ-specific doses are below 10 cSv, and the central values are below 1 cSv. The lower confidence limits on these doses are well below levels that have been considered as limits of epidemiological detection in studies of cohorts of other exposed populations. The large uncertainty, combined with the small number of individuals comprising Category I consumers, diminishes the statistical power available to detect a dose response through epidemiological investigation. Therefore, it is unlikely that any observed trends in the incidence of disease in populations that utilized the Clinch River and Lower Watts Bar Reservoir after 1944 could be conclusively attributed to exposure to radionuclides released from the X-10 site, even though this present dose reconstruction study has potentially identified increased individual risks resulting from these exposures." Also, the Task 4 report was reviewed by the Oak Ridge Health Agreement Steering Panel (ORHASP)—a panel of experts and local citizens appointed to direct and oversee the Oak Ridge Health Studies. On page 12 of the ORHASP's final report titled *Releases of Contaminants from Oak Ridge Facilities and Risks to Public Health* (available at http://www2.state.tn.us/health/CEDS/OakRidge/ORHASP.pdf), the panel determined, "Although the White Oak Creek releases caused increases in radiation dose, the calculated exposures were small, and less than one excess cancer is expected." In addition, on page 38 of the ORHASP report regarding the number of health effects that would be expected from exposure to X-10 radionuclide releases via White Oak Creek, the panel estimates "less than one excess cancer case from 50 years of contaminated fish consumption" would result. On page 147 of the final public health assessment, "ATSDR concludes that exposures to X-10 radionuclides released from White Oak Creek to the Clinch River and to the Lower Watts Bar Reservoir are not a health hazard. Past and current exposures are below levels associated with adverse health effects and regulatory limits. Adults or children who have used, or might continue to use, the waterways for recreation, food, or drinking water are not expected to have adverse health impacts due to exposure. ATSDR has categorized those situations as posing *no apparent public health hazard* from exposure to radionuclides related to X-10. This classification means that people could be or were exposed, but that their level of exposure would not likely result in adverse health effects."

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		Thus, even though ATSDR used a dose methodology and considered the 50th percentile estimates, while the Task 4 team used a risk model and the upper 95th percentile dose and risk levels, ATSDR came to the same basic conclusion. ORHASP found that less than one excess cancer case would be expected to occur as a result of exposure to X-10 radionuclide releases via White Oak Creek; ATSDR concluded that this exposure was not expected to cause adverse health effects.
	The premise that best estimate (mean or median) values are inadequate for communicating with the general public is another statement based on facts not in evidence. The public has little appetite for statistics that they don't think they need. What they do want is straight answers, not maybes. Median values give the public what they want and expect.	Thank you for your comment. As described above, we agree that using the 50th percentile estimates provide a much more realistic framework for evaluating exposures to the public.
13	The annual variation in risks from consumption of 1 lb of fish caught near Grassy Creek (CRM 14) from 1944–1991, given in Table 13.11 of the Task 4 report, can be used as a surrogate for the variation over time in doses resulting from consumption of fish caught near Jones Island. Doses (risks) estimated in this manner for the period 1944–1948 were three times greater than the average [which was estimated from the sum of risks for each year in the period given in the table (2.4×10^{-6}), divided by 48 years]. Thus, the upper credibility limits of doses to all Category I fish consumers of fish caught near Jones Island during 1944–1948 would be about 230 mrem/year, and thus well above the dose (limit) used for comparative purposes by the ATSDR. The upper credibility limits of the dose estimates calculated in this way fall to less than 100 mrem/year (averaging ~40 mrem/year) during the period from 1950–1953. They increase again during 1954–1959 to average levels that are nearly identical to those incurred during 1944–1949. Not surprisingly, the peak releases of Cs-137, which is the primary contributor to the dose from fish consumption and to the doses from several other pathways (see Tables 13.8 and 13.9 in the Task 4 report), took place during the years 1944–1949 and 1954–1959 (see Table 2 and Fig. 21 in the ATSDR PHA). Based on the information presented in the SENES Oak Ridge, Inc., Task 4 Report, in Table 13.11 (Annual risk / lb of fish at CRM 14), Fig. 13.3 (Comparison of risks at different CRM), Table 12.11 (Risk coefficients), and Page 13-4 (fish consumption rates for different categories of people), I can state that the upper bound of doses from fish consumption at CRM 20.5 (Jones Island) and CRM 14.0 exceeded 100 mrem/yr in some years (e.g., 1946, 1956) for people in fish consumption Categories I (about 20	Because the use of the upper bound value artificially increases the risk as the calculated uncertainty in many cases is at least an order of magnitude or greater than the 50th percentile value, ATSDR used the 50th percentile (central) value from the Task 4 of the Tennessee Department of Health's Reports of the Oak Ridge Dose Reconstruction (Task 4 report). The values calculated by ATSDR are in line and agree with the Task 4 values, even though the methods of analyses were different (see the response to comment 12 for more information on how these different methods were used to develop the same basic conclusions). ATSDR uses the central values in this public health assessment because they provide the most realistic doses for potential exposures to radionuclides in the Clinch River and the Lower Watts Bar Reservoir. Central estimates are used because they describe the risk or dose for a typical person. When considering central estimates, half of the potential doses will fall above and half will fall below the estimate. Therefore, a person's actual dose would most likely be closer to the central value than near the high or low end of the range of dose estimates. In fact, ATSDR's external reviewers who evaluated documents associated with the Oak Ridge Dose Reconstruction recommended emphasizing the central estimate rather than the upper and lower bounds of the dose distribution. As noted above, the commenter is using the maximum annual dose calculated from the upper 95th percent confidence level in the Task 4 Report. This unrealistic, upper-bound value artificially increases the doses. Although this method may be appropriate for regulatory matters, ATSDR uses the central values (50th percent or mean value). The agency believes this is a more realistic expression of the potential for exposure and resulting dose. The scenarios associated with using the upper-bound (95% confidence level) to estimate the maximum annual dose would require over many years almost daily intakes of the maximum concentrations found in water and fish associated with a specific location around Jones Island.

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	kg/yr) and II (10 kg/yr). Doses from drinking water or from external exposure to contaminated sediments are not included in these tables. Using a nominal radiogenic lifetime risk of cancer incidence of 8% per Sv, and dividing into the reported upper bound risk levels (which are the result mostly of uncertainty associated with exposure to Cs-137) indicates that individual cumulative whole body doses could have been larger than the ATSDR whole body radiogenic cancer CV of 5000 mrem. Given that the peak exposures occurred within two five-year periods between 1944 and 1959, it can be shown that the maximum annual doses could have exceeded 100 mrem/y during these years. By contrast, the annual dose reported in the ATSDR PHA is 4 mrem. ATSDR does not acknowledge that there are large uncertainties in these estimates, and that, because of large variations in releases from White Oak Creek over time, annual doses to individuals exposed in the 1940s and 1950s, when releases were at their highest levels, would have been significantly higher than values based on an average dose over 48 years. In his opinion, inappropriate averages were being used to present a positive view of the results. When the increased levels of annual releases and exposure (i.e., consumption of fish caught during the 1940s and 1950s when releases were much higher than the average) are factored into the analysis, effective doses exceed the 100-mrem per year dose limit at the upper limit of the 95% credibility interval of the annual dose received via all pathways of exposure.	The nominal cancer risk factor used by many regulatory agencies, including the U.S. Environmental Protection Agency (EPA), the U.S. Nuclear Regulatory Commission (NRC), and the U.S. Department of Energy (DOE), is 5%—not 8% as indicated by the commenter. The 8% includes cancer, hereditary effects, and other non-specific risks. The method described by the commenter is used as a first approximation of the annual dose. The EPA, NRC, and DOE generally use this method in determining the accumulated dose in the first year following an intake. This issue was discussed at several Exposure Evaluation Work Group meetings (EEWG, formerly known as the Public Health Assessment Work Group [PHAWG]) and at the Oak Ridge Reservation Health Effects Subcommittee (ORRHES) meetings where the screening process was discussed. The reason for dividing the total dose by 48 years (for certain exposure scenarios, ATSDR divided the total dose by a different number of years; see Table 10 in the final PHA for these specific scenarios) was to establish a first approximation of the dose. This would allow for comparison to the 100 mrem/year dose limit recommended for the public by the International Commission on Radiological Protection (ICRP), the National Council on Radiation Protection and Measurements (NCRP), the NRC, and ATSDR's minimal risk level (MRL). Furthermore, as specified in ICRP Publication 60, "The limit should be expressed as an effective dose of 1mSv [millisievert] [100 millirem] in a year. However, in special circumstances a higher value of effective dose could be allowed in a single year, provided that the average over 5 years does not exceed 1 mSv per year." ATSDR approximated the annual whole-body dose for each pathway by applying weighting factors to the Task 4's estimated 50th percentile organ-specific doses, adjusting for a 1-year exposure, and summing the adjusted organ doses across each pathway. The first approximation value of 4.0 mrem/year for past exposures is 25 times less than the 100 mrem/year dose limit recommended for the public by the ICRP, NCRP, and NRC. Because this approximated value was so much lower than the dose limit recommended for the public during the screening-level evaluation, no further actions were necessary. Had the approximation shown an annual dose close to 100 mrem/year, ATSDR would have re-assessed the evaluation and conducted further investigation.
14	P. 57. Line 23 et seq. The quoted conclusion from the ORHASP report about past releases and harm need to be reconciled with the conclusions of this report.	The comment is noted. The following text was added to clarify that these risks were not associated with radionuclides from X-10, but with elevated mercury and PCB concentrations: "ORHASP noted, however, the Task 4 report determined that following exposure to fish contaminated with X-10 radionuclides via White Oak Creek, less than one excess cancer case was expected. Studies also indicate that elevated PCB concentrations drove the health risks associated with eating fish from the Clinch River and Watts Bar

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		Reservoir."
15	Page 84, Table 9. Summary of Estimated Organ-Specific (Equivalent) Radiation Doses For Past Exposure Pathways. One more overly complex and undecipherable table. Stakeholders are wondering if this is intentional on ATSDR's part. Is ATSDR attempting to bury critical information in technical jargon and a cobbling of critical exposure information? If this is not, in fact intentional on ATSDR's part, it certainly is obscuring to the stakeholders. Most stakeholders hold little hope that ATSDR can improve its public health practice without a sea change in both its cooperate attitude and its senior management. *(Comment received on the initial release PHA dated December 2003.)*	This table was changed in subsequent revisions and is presented in the final PHA as Table 11. Summary of Estimated Organ-Specific Doses and Whole-Body Doses for Each Past Radiation Exposure Pathway and the Estimated Lifetime Organ-Specific Doses and Lifetime Whole-Body Doses From All Past Radiation Exposure Pathways. This table provides the whole-body and organ-specific doses for all of the pathways of interest in the Task 4 of the Tennessee Department of Health's Reports of the Oak Ridge Dose Reconstruction (Task 4 report). ATSDR is unclear on what information could be buried in this table and on what "technical jargon" is used. Without more information or specific details on what is undecipherable, ATSDR is not sure what changes could be made. But please note that the table has been completely modified since December 2003. It now consists of numbers (doses) only and provides footnotes to explain how the doses were calculated and where the information was obtained from (various tables in the Task 4 report). ATSDR believes that the table provides necessary information on these doses and how they were calculated. For more information, please refer to the Task 4 report available online at http://www2.state.tn.us/health/CEDS/OakRidge/WOak1.pdf and see Appendix D for a brief on the 1999 Task 4 report. Copies of the Task 4 report are also available at the DOE Information Center located at 475 Oak Ridge Turnpike, Oak Ridge, Tennessee (telephone number: 1-865-241-4780).
16	P. 84. Table 11. A preliminary check of the organ doses, weighting factors, products, and sums (effective doses), between the Task 4 report and this report indicates that the numbers given in this report have been abbreviated with respect to those given in the Task 4 report. Therefore, it is not obvious that the numbers supposedly leading to the stated effective doses given in this report are numerically consistent, by themselves, with their stated relationship. Consequently, this will have to be demonstrated by a table of doses, weighting factors, products, and sums that, by calculation, actually agree with the results given on p.84. Otherwise, the stated results given in this report will have greatly diminished credibility.	The only difference between the tables is that Table 11 in the final PHA presents the doses in millirem, whereas the Task 4 of the Tennessee Department of Health's Reports of the Oak Ridge Dose Reconstruction (Task 4 report) uses centisieverts. For example, in Table 13.3 on page 13-6 of the Task 4 report, the Category I bone dose for male fish consumers is 0.81 centisieverts, which is 0.81 rem or 810 millirem—the value presented in Table 11 of the final PHA. Instead of creating another table, a footnote has been added to Table 11: "To compare the doses in the Task 4 report to the doses in this table, 1,000 mrem is equal to 1 centisievert (cSv). For example, 810 mrem (organ-specific radiation dose to the bone for fish ingestion at Jones Island) divided by 1,000 would equal 0.81 cSv—the same value presented in Table 13.3 of the Task 4 report."
17	Page 84, table 11: The values given in Columns 2–6 in the last row of the table bear little or no relationship to the information upon which they were reportedly based. For example, if we apply ATSDR's formula to estimate a 70-year organ/tissue dose for bone (surface), we get a value of 1181 mrem from ingestion of fish caught near Jones Island alone. If we include	As a conservative measure, ATSDR recalculated the estimated committed equivalent doses presented in Table 11 to account for individuals who could have been exposed via all of the pathways and at all of the locations presented in the table. To approximate a committed equivalent dose to an organ over 70 years, ATSDR summed the organ-specific radiation doses from the Task 4 of the Tennessee Department of Health's Reports of the Oak Ridge

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	the lowest estimates of doses to bone from the other exposure pathways, we obtain an additional dose of ~24 mrem. The sum of these two doses exceeds 1200 mrem. If we perform the same exercise for the data in Columns 3 and 4, the totals are <900 mrem. The values in Columns 5 and 6 in the last row of the table would make sense if they were reversed.	Dose Reconstruction (Task 4 report) based on up to 48 years of exposure (for certain exposure scenarios, the dose was based on a different number of years; see Table 10 in the final PHA for these specific scenarios)—divided by 48, multiplied by 70 years, and rounded up.
18	Page 85, lines 8–9 (also Page 5, line 9), 11: The statement needs to be revised to say "at least 6 times greater ... from drinking water ingestion, eating meat and milk, and via external radiation." The doses to both the breast and the skin from external radiation at Kingston were about 6.5 times those from eating fish (Table 12), and drinking water ingestion was omitted from the original listing of pathways. The table reference in line 11 should have been to Table 11, and not to Table 10.	Once the worst-case drinking water ingestion dose at K-25/Grassy Creek is incorporated into this statement, it would be "6 times greater." The change was made in the final PHA. Also, we believe the commenter meant to say "about 6.5 times *less than* those from eating fish." Thank you for the comment. The change was made in the final PHA.
19	Page 87, paragraph 3: Where are the data for the dose calculations to Happy Valley residents presented? Based on what is said, it is clear that the 50th percentile estimates of annual doses from fish consumption would have been about 35 mrem/year. By analogy with the comments on the material in paragraph 3 on page 5, 95th percentile estimates of the effective doses would have exceeded the 100 mrem/year criterion and the 95th percentile estimates of the organ/tissue doses would undoubtedly have exceeded the 5000 mrem total dose criterion as well (see results for the Grassy Creek Area, Clinch River Mile 14, in Table 13.A).	As a note of clarification, the commenter is making statements regarding "fish consumption" related to ATSDR's evaluation of Happy Valley residents in the PHA. To clarify, this part of Section III in the PHA refers to **drinking water ingestion** for Happy Valley residents, not fish consumption. Consequently, the commenter's statements do not apply to the referenced section of the document. Regarding this drinking water evaluation, the Task 4 of the Tennessee Department of Health's Reports of the Oak Ridge Dose Reconstruction (Task 4 report) conducted an analysis of exposure to X-10 contaminants via the K-25 water intake, but not a separate analysis for residents living in the Happy Valley settlement such as ATSDR conducted in this public health assessment (described on pages 90–91 of the final PHA). ATSDR used the 50th percentile of the modeled radioactivity concentrations in the Grassy Creek area of the Clinch River from the Task 4 report. Given ATSDR's derived annual whole-body doses for these residents, the highest annual radiological dose to a hypothetical Happy Valley resident (residing there from 1944 to 1950) from drinking water from the K-25 water intake was 14 mrem or 98 mrem over the 7-year period. This annual dose is at least seven times less than the 100 mrem/year dose recommended for the public by the International Commission on Radiological Protection (ICRP), the National Council on Radiation Protection and Measurements (NCRP), and the U.S. Nuclear Regulatory Commission (NRC). See Sections III.B.2. and IV.B. in the final PHA for more details.
20	Page 111, table 22: This table presents the summed doses from Table 11, which are erroneous as discussed above, in Column 3; the ATSDR criteria used to assess whether the doses represent a health hazard in Column 4;	As a conservative measure, ATSDR recalculated the estimated committed equivalent doses presented in Table 11 to account for individuals who could have been exposed via all of the pathways and at all of the locations presented in the table. To approximate a committed

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	the results of the comparison (Column 5); and the conclusion that these (1) are not likely to cause adverse health effects and (2) that releases from White Oak Creek were not a public health hazard. Because the doses are in error, for reasons given above, all of the comparisons and the conclusions need to be revised. In addition, the implication that these releases could not have caused any adverse health effects in at least some exposed individuals is improper, and should be purged from the document, along with other such statements, for reasons discussed earlier.	equivalent dose to an organ over 70 years, ATSDR summed the organ-specific radiation doses from the Task 4 of the Tennessee Department of Health's Reports of the Oak Ridge Dose Reconstruction (Task 4 report)—based on up to 48 years of exposure (except where noted in Table 10 of the final PHA)—divided by 48, multiplied by 70 years, and rounded up. These changes have been reflected in Table 22. Still, even with considering potential exposures via all of the pathways and at all of the locations presented in Table 11, all estimated doses are below levels shown to cause adverse health effects. Based on our evaluation in this public health assessment, ATSDR concludes that exposures to X-10 radionuclides released from White Oak Creek to the Clinch River and to the Lower Watts Bar Reservoir are not a health hazard. Past and current exposures are below levels associated with adverse health effects and regulatory limits. Adults or children who have used, or might continue to use, the waterways for recreation, food, or drinking water are not expected to have adverse health impacts due to exposure. ATSDR has categorized those situations as posing *no apparent public health hazard* from exposure to radionuclides related to X-10. This classification means that people could be or were exposed, but that their level of exposure would not likely result in any adverse health effects. This commenter is incorrect in implying that the document states "these releases could not have caused any adverse health effects." This is clearly evident by the use of the *no apparent public health hazard* conclusion category in this public health assessment. ATSDR uses this category in situations in which human exposure to contaminated media might be occurring, might have occurred in the past, or might occur in the future, but where the exposure **is not expected** to cause any harmful health effects. Therefore, ATSDR is not saying that these releases could not have caused any health effects. On the contrary, we are saying that radiation exposure is possible, but that this exposure is not expected to result in adverse health effects.
21	The ATSDR PHA states that dose estimates in the original Task 4 report of the Oak Ridge Dose Reconstruction were conservative (i.e., likely to overstate true doses to real persons). This conclusion is not true. The Task 4 report was specifically designed to produce realistic dose and risk results for reference individuals, fully accounting for the presence of multiple sources of uncertainty. The uncertainty about central values of dose is substantial, approaching a factor of 10 or more about the 50th percentile value. It has published the conclusion that our past work produced "conservative" estimates of dose without justification. Our estimates of doses to	In the Task 4 of the Tennessee Department of Health's Reports of the Oak Ridge Dose Reconstruction (Task 4 report), the authors state that they used measured concentrations when available. But if these data were not available, estimations were made via the use of modeled parameters. These estimations were subjective probability distributions as discussed in Chapter 4 of the task report. Given the nature of the subjective analyses, ATSDR believes these to be appropriately conservative in nature and application. As discussed in NCRP Commentary 14 entitled A Guide for Uncertainty Analysis in Dose and Risk Assessments Related To Environmental Contamination, a quantitative uncertainty analysis, "usually requires that the state of knowledge about the uncertain components of the mathematical model be described by probability distributions." If this knowledge is

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	representative individuals as the result of past operations at ORNL were made without the intent to bias the conclusions in a manner that would overestimate the true exposure. This is precisely why we embraced the application of quantitative methods of uncertainty analysis. The summary document indicated that the Task 4 Report was inherently conservative. In his opinion, he said, this means that there is an inherent bias towards overstating the truth of unknown exposure or risk, which according to him, was not true and was the reason quantitative uncertainty analysis was used in the approach.	unavailable, then professional judgment is used to evaluate the site-specific parameters. NCRP Commentary 14 also states that if the results of an assessment indicate that doses are below regulatory limits, then a quantitative uncertainty analysis may not be necessary. The Task 4 report used conservative parameters to estimate a 95% confidence interval for risks and doses from past exposures to X-10 radionuclides released to White Oak Creek. ATSDR calculated doses using the findings of the Task 4 report, and obtained estimated doses that were well below very conservative, regulatory limits. In developing their conclusions, the Task 4 authors used a worst-case scenario considering the upper confidence limits for the highest fish consumers ingesting fish caught near Jones Island (the study area with the highest detected radionuclide concentrations). Even using this worst-case scenario, the Task 4 authors concluded that "the upper confidence limits on the estimated organ-specific doses are below 10 cSv [centisievert]…," which lies in the range that the authors describe as "clearly below the limits of epidemiological detection (1 to 30 cSv) for radiation-induced health outcomes that have been observed following irradiation of large cohorts of individuals…" Therefore, even considering this worst-case scenario, the Task 4 authors found that "…for the exposure pathways considered in this task, the doses and risks are not large enough for a commensurate increase in health effects in the population to be detectable, even by the most thorough of epidemiological investigations." NCRP Commentary 14 also states that, following an uncertainty analysis, if the 95th percentile exceeds a standard or regulatory limit and the 50th percentile is less than the standard or regulatory limit, then additional evaluations may be recommended (page 23). ATSDR performed this additional evaluation and concluded that the more reasonable result was that the doses received from the intake of potentially contaminated foods (the pathway yielding the highest doses) were below regulatory limits and levels of a public health hazard. Even if doses from all other pathways evaluated were combined with the ingestion pathway, the doses were still sufficiently low and below levels where tolerable and observable adverse health effects would be expected.
22	The belief that the contents of the Task 4 report have not been considered is not accurate, certainly with respect to the Exposure Evaluation Work Group (EEWG). I presented the chain of logic used to develop best estimate (median) values of dose and risk in the Task 4 report to the then Public Health Work Group (PHAWG) on July 19, 2004. This information was supplementary to the attention given to the Task 4 report by the authors of the White Oak Creek PHA. The work of the EEWG is a team effort. Individuals do not seek credit for their comments on the draft PHAs.	Thank you for your comment.

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23	There are major technical inaccuracies, misinterpretations, and omissions in the dose and risk information obtained from the original Oak Ridge Dose Reconstruction (Task 4) reports. The most serious of these issues involve the lack of consideration of information on uncertainty in dose and risk, the failure to report individual risk estimates, the failure to report the 95% credibility intervals on dose and risk, and lifetime averaging of doses over the entire period of release, obscuring the relatively high annual doses for the early years of release (1944-1949, 1954-1959) to give the impression that annual doses were acceptably small.	ATSDR did not omit, misrepresent, or have technical inaccuracies in the information used from the Task 4 of the Tennessee Department of Health's Reports of the Oak Ridge Dose Reconstruction (Task 4 report) for the evaluation in this public health assessment. The dose information obtained from the Task 4 report was accurate and data relevant to this evaluation were not omitted. ATSDR evaluated the need for an uncertainty analysis as outlined in NCRP Commentary 14 titled *A Guide for Uncertainty Analysis in Dose and Risk Assessments Related to Environmental Contamination.* In essence, the use of conservative and biased screening calculations indicated the possible resulting dose would be clearly below a regulatory limit. "Conservative screening calculations are designed to provide a risk estimate that is highly unlikely to underestimate the true dose or risk. Therefore, a more detailed analysis will likely demonstrate that the true risk is even less." The document states that screening can be considered among the first steps in conducting an uncertainty analysis as this roughly defines the upper and lower bounds of a distribution of exposed populations or individuals. If these screening calculations are to be used successfully, a decision point has to be determined to establish the boundary at which no further analyses are necessary. According to NCRP Commentary 14, "For example, for dose reconstruction, the National Academy of Sciences has suggested that an individual lifetime dose of 0.07 Sv [sievert] be used as a decision criterion for establishing the need for more detailed investigation (NAS/NRC 1995 [National Research Council. 1995. Radiation dose reconstruction for epidemiologic uses. Committee on an assessment of CDC radiation studies. Board on Radiation Effects Research, Commission on Life Sciences. Washington, DC: National Academy of Sciences.])." A value of 0.07 Sv is equivalent to 7 rem or 7,000 mrem—a value that is 40% higher than ATSDR's radiogenic cancer comparison value of 5,000 mrem over 70 years. Thus, ATSDR's screening value is more conservative than the criteria suggested by the National Academy of Sciences as reported by the NCRP. Regarding risk estimates, please see Appendix F in the final PHA and the response to comment 44 within this appendix. ATSDR uses the central values—not the upper-bound value of the dose estimates—because these provide the most realistic doses for potential exposures to radionuclides in the Clinch River and the Lower Watts Bar Reservoir. Central estimates are used because they describe the risk or dose for a typical, realistic individual. When considering central estimates, half of the potential doses will fall above and half will fall below the estimate. Therefore, an individual's actual dose would most likely be closer to the central value than near the high or low end of the range of dose estimates. In fact, ATSDR's external reviewers who evaluated documents associated with the Oak Ridge Dose Reconstruction

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		recommended emphasizing the central estimate rather than the upper and lower bounds of the dose distribution. The method described by the commenter is used as a first approximation of the annual dose. This method is generally used by many agencies, including the U.S. Environmental Protection Agency (EPA), the U.S. Department of Energy (DOE), and the U.S. Nuclear Regulatory Commission (NRC) in determining the accumulated dose in the first year following an intake. This issue was discussed at several Exposure Evaluation Work Group meetings (EEWG, formerly known as the Public Health Assessment Work Group [PHAWG]) and at the Oak Ridge Reservation Health Effects Subcommittee (ORRHES) meetings where the screening process was discussed. The reason for dividing the total dose by 48 years (for certain exposure scenarios, ATSDR divided the total dose by a different number of years; see Table 10 in the final PHA for these specific scenarios) was to establish a first approximation of the dose, as this would allow for comparison to the 100 mrem/year dose limit recommended for the public by the International Commission on Radiological Protection (ICRP), the National Council on Radiation Protection and Measurements (NCRP), the NRC, and ATSDR. ATSDR approximated the annual whole-body dose for each pathway by applying weighting factors to the Task 4's estimated 50th percentile organ-specific doses, adjusting for a 1-year exposure, and summing the adjusted organ doses across each pathway. The first approximation value of 4.0 mrem/year for past exposures is 25 times less than the 100 mrem/year dose limit recommended for the public. Because this approximated value is so much lower than the dose limit recommended for the public during the screening-level evaluation, no further actions were necessary. Had the approximation shown an annual dose close to 100 mrem/year, ATSDR would have reassessed the evaluation and conducted further investigation.
Evaluation of Current and Future Exposures		
24	Page 6, Line 17: ATSDR has determined that exposure to the current levels of radionuclides in the surface water, sediment, fish, and game are not expected to cause any harmful health effects in the present and future. Therefore, ATSDR concluded that current and future off-site exposure to radionuclides in the Clinch River and the LWBR via White Oak Creek is not a public health hazard. The statement seems to assume conditions on the ORR will remain static in the future. This does not seem likely, given the longevity (e.g., millions of years) and dynamics associated with many of the contaminants that will be left in place, as well as the complexity of the site as whole. To a large degree, assurance that the health of the public and environment will be	Thank you for your comment. Text in Section I. Summary of the final PHA was changed to the following: "ATSDR's review of environmental data collected in and around the Clinch River and LWBR areas shows that the following practices ■ annual environmental monitoring, ■ institutional controls intended to prevent disruption of sediment, ■ on-site engineering controls to prevent off-site contaminant releases, and ■ DOE continuing its expected appropriate and comprehensive system of monitoring (e.g., of remedial activities and contaminant levels in media), maintenance, and institutional and engineering controls, have limited exposure to the current levels of radionuclides in surface water, sediment, fish, and game to the point that radionuclides are not expected to cause any current or future

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	protected in the future appears to rely on the demonstrated success of current remedial activities and DOE's commitment to providing perpetual support of a comprehensive system of monitoring, maintenance, and institutional controls. To support that contention that there will be no detectable public health effects from exposures to future WOC radionuclide releases, wording should be added that current remediations and engineering controls at existing operable units in the White Oak Creek watershed must be maintained for the foreseeable future. The future safety of the public is dependent upon a continuing long term stewardship program which will ensure the integrity of the engineering controls that are being installed upstream in Melton Valley and elsewhere. P. 7. Line 4. Concerning future exposures, has ATSDR evaluated the effects of current environmental restoration activities at ORNL?	harmful health effects. Given this evaluation, ATSDR concludes that current and future off-site exposure to radionuclides in the Clinch River and the LWBR via White Oak Creek is not a public health hazard." Similar text was also added to Section IV. Public Health Implications and Section VIII. Conclusions of the final PHA regarding future exposures.
25	P. 34. The conclusions of the baseline risk assessment (Jacobs EM Team 1997b) appear to imply that consuming any fish taken from Poplar Creek, or bass from the Clinch River below Melton Hill Dam, pose a health risk. CRM 20.5 at Jones Island is only about three miles below Melton Hill Dam. How are the Jacobs conclusions to be reconciled with the final conclusions of this report?	Your comment is noted. The text has been clarified to explain that primary risks in DOE's risk assessment were not associated with radionuclides in fish: "The assessment also determined that because of PCB and mercury contamination, the consumption of any type of fish in Poplar Creek posed a health risk. Similarly, consumption of bass from the Clinch River below Melton Hill Dam posed a health risk due to PCB contamination. Still, no primary risks were associated with exposure to radionuclides in fish from the Clinch River or from Poplar Creek."
26	The document should explain why some past waste-disposal sites, which are not current public health concerns, are now subject to remediation. Though expensive, this ensures that long-term safety is maintained and that catastrophic or chronic releases are prevented, or at minimum, detected in a timely manner. It may also be necessary to meet environmental contamination standards which are often more stringent than human health criteria. The rationale of spending money now on currently satisfactory waste disposal scenarios in order to maintain their long-term safety should be explained. How can a responsible party recommend putting off necessary maintenance until after the disaster has occurred? *An ounce of prevention is worth a pound of cure.*	The following text was added to the introductory portion of Section II.C. Remedial and Regulatory History: "Although not current public health concerns, some of these former waste disposal sites are nonetheless subject to remediation. DOE is remediating these sites to ensure long-term safety is and to prevent off-site releases. More information on DOE's environmental management program can be obtained at http://www.oakridge.doe.gov/External/Default.aspx?tabid=42."

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ATSDR's Health Guidelines for Radiation Effects		
27	Similar concerns appear when we look at individual organ or tissue doses, where, in some cases, the upper credibility limit of the cumulative doses exceed the ATSDR's radiogenic cancer "Comparison Value" of 5000 mrem over 70 years. For example, the upper credibility limits of cumulative doses to bone surfaces for individuals of either sex who were Category I consumers of fish caught near Jones Island exceeded 7000 mrem over 48 years. The upper credibility limit of cumulative dose to the lower large intestine for males who were Category I consumers of fish caught near Jones Island was 5200 mrem over 48 years. Upper credibility limits of cumulative doses to red bone marrow for individuals of either sex who were Category I consumers of fish caught near Jones Island were 4800 mrem over 48 years, and the upper credibility limit of the cumulative dose to the lower large intestine for females who were Category I consumers of fish caught near Jones Island was 4500 mrem over 48 years. Addition of doses received via other pathways could increase each of these doses by another 10–20%, and adjusting for a 70-year exposure results in an increase of 46% (see Table 11 on page 84). Thus, the upper credibility limits for the cumulative doses for all of the organs or tissues cited above would exceed the ATSDR's 5000-mrem criterion when extended over 70 years. For whole body exposures, the excess risk of cancer incidence associated with the 5000 mrem CV *exceeds several chances in one thousand*. Consideration of the uncertainty in radiogenic cancer risk, as obtained using the NIH update of the 1985 Radioepidemiological Tables (Land et al., 2003) combined with information on the baseline incidence of cancer from the NCI SEER registry (1973-2002), would show that a cumulative whole body dose of 5000 mrem could approach or *exceed an excess lifetime risk of cancer incidence of one chance in 100* depending on the individual's gender and age during the years of highest exposure. At the dose levels equal to ATSDR's radiogenic cancer CVs, the relative risk of radiogenic cancer could be sufficiently high to warrant compensation and medical care for those who were exposed before the age of twenty and have been diagnosed with cancer a few decades later. [This statement applies only if the same relative risks used for compensating sick DOE workers for Cold War era exposures to radiation	ATSDR uses the central values—not the upper-bound value of the dose estimates. These provide the most realistic doses for potential exposures to radionuclides in the Clinch River and the Lower Watts Bar Reservoir. Because the use of the upper-bound value artificially increases the risk as the calculated uncertainty in many cases is at least an order of magnitude or greater than the 50th percentile value, ATSDR used the 50th percentile (central) value from the Task 4 of the Tennessee Department of Health's Reports of the Oak Ridge Dose Reconstruction (Task 4 report). The values calculated by ATSDR are in line and agree with the Task 4 values, even though the methods of analyses were different (see the response to comment 12 for more information on how these different methods were used to develop the same basic conclusions). Central estimates describe the risk or dose for a typical, realistic individual. When considering central estimates, half of the potential doses will fall above and half will fall below the estimate. Therefore, an individual's actual dose would most likely be closer to the central value than near the high or low end of the range of dose estimates. In fact, ATSDR's external reviewers who evaluated documents associated with the Oak Ridge Dose Reconstruction recommended emphasizing the central estimate rather than the upper and lower bounds of the dose distribution. When using the central estimates, all estimated doses in this public health assessment were below levels shown to cause observable and tolerable effects. In fact, ATSDR's calculated whole-body dose for past exposures via all pathways was 278 millirem over 70 years—more than 17 times less than ATSDR's radiogenic cancer comparison value of 5,000 millirem over 70 years. The risk range cited is the typical risk range used by the U.S. Environmental Protection Agency (EPA) in its evaluations of contaminants in the environment. Many of these evaluations may not necessarily be based on health, but could be based entirely on risk assessments. The ATSDR Cancer Policy Framework, adopted in 1993, addresses many factors to be evaluated in analyzing environmental exposures. ATSDR recognizes that, at present, no single generally applicable procedure for exposure assessment is available, and therefore exposures to carcinogens are best assessed on a case-by-case basis with an emphasis on prevention of exposure. "A risk assessment does not measure the actual health effects that hazardous chemicals at a site have on people. Risk assessments are conducted without determination of actual exposure." A PHA "reviews site-related environmental data and general information about toxic chemicals. Then it compares an estimate of the amount of chemical exposure (i.e., dose) to which people might frequently encounter in situations that have been associated with disease and injury. However, unlike a risk assessment, a PHA factors in information from the adjacent community about actual or likely exposures and information from the community about their health concerns."

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	were to be extended to the general public. The National Research Council/National Academies of Sciences (2005) has recently recommended that Congress consider such an extension.] For example, the relative risk would be in the compensable range for a person exposed at age 10 and diagnosed with acute lymphocytic leukemia at age 20, when the whole body dose is 5,000 mrem. In his opinion, implying that there is no public health concern below 5,000 mrem over 70 years is wrong. ATSDR staff health physicists appear to be relying on the advice of others within the Health Physics community who erroneously claim that there is no evidence for increased cancer risk below an effective whole body dose of 10 rem and who urge that risk not be quantified at effective whole body doses below 5 rem in one year or 10 rem lifetime. The possible extent of dose underestimation is large enough that, under some circumstances, both the ATSDR MRL of 100 mrem for exposure in a single year and cancer Comparison Values for the whole body and the lower large intestine (5000 mrem) could have been exceeded.	Therefore, it is not appropriate to base the decision of public health on risk assessment cleanup criteria. See the response to comment 44 for additional information distinguishing a risk assessment from a health assessment. In this public health assessment, ATSDR compares annual doses to the 100 mrem/year dose limit of the International Commission on Radiological Protection (ICRP), the National Council on Radiation Protection and Measurements (NCRP), and the U.S. Nuclear Regulatory Commission (NRC), as well as ATSDR's minimal risk level (MRL). ATSDR compares lifetime doses to the agency's radiogenic cancer comparison value of 5,000 mrem over 70 years, which is based on peer-reviewed literature and other documents developed to review the health effects of ionizing radiation. These values, used as screening tools during the public health assessment process, are levels below which adverse health effects are not expected to occur. If the screening indicates that past or current doses exceed our comparison values, then we would conduct further in-depth health evaluation. ATSDR incorporated safety margins when developing its screening values for radiation exposures. The approach ATSDR uses to derive MRLs, such as those in the Toxicological Profile for Ionizing Radiation, was developed in collaboration with the EPA. The screening value includes the use of a no observed adverse effect level (NOAEL) or a lowest observed adverse effect level (LOAEL) as well as three or more situation-specific uncertainty factors. When multiplied, these factors give a total uncertainty factor generally ranging from 1 to 1,000, based on the studies used. Furthermore, the ATSDR legislative authority, as discussed many times, limits ATSDR to evaluate exposures based on observable and tolerable adverse health effects. If adverse health effects are not observed in an epidemiological study, then the doses used in the study should be considered tolerable. ATSDR's radiogenic comparison value of 5,000 millirem over 70 years incorporates the linear no-threshold (LNT) model for evaluating public health hazards associated with exposure to radiation. It assumes a total lifetime dose (70 years of exposure) above background that is considered safe in terms of cancer induction. In addition to the LNT model, ATSDR also incorporates a margin-of-dose (MOD) approach into this comparison value. During an evaluation, if ATSDR determines that further investigation is needed, scientific literature associated with radiological doses and dose estimates—particularly those related to adverse health effects—is reviewed. Then, ATSDR compares the dose estimates from scientific literature to site-specific dose estimates. Thus, ATSDR uses the LNT model to determine when a more detailed site-specific evaluation is necessary, and uses the MOD approach to develop realistic information for communities regarding what is known and unknown about radiation levels at a particular site.

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		An independent expert panel convened to review site-specific approaches that ATSDR used to evaluate past, current, and future radiation risks to communities surrounding the Oak Ridge Reservation. The panel concluded that this combination of approaches (LNT and MOD) is appropriate for ATSDR to determine radiation levels at which health effects actually occur. The panel found that ATSDR's use of the MRL of 100 millirem and radiogenic cancer comparison value of 5,000 millirem were appropriate screening values. If extrapolated over 70 years assuming constant exposure, the radiogenic cancer comparison value dose estimate would be about 71 millirem per year—a level the panel determined to be protective of public health in terms of cancer and noncancer risks. The panel also concluded that ATSDR's approach considers evidence for both individual organs and whole-body doses (effective doses), noting that a whole-body dose could not be developed without accounting for doses to single organs. Further, the panel determined that ATSDR's method of distinguishing dose levels from risk levels was acceptable because ATSDR incorporated risk and LNT explicitly and implicitly when calculating doses. In the words of one peer reviewer regarding ATSDR's radiogenic cancer comparison value, "The general consensus is that the linear non-threshold hypothesis is scientifically reasonable for the purpose of radiation protection. The recent NCRP comprehensive review and UNSCEAR [United Nations Scientific Committee on the Effects of Atomic Radiation] evaluations do not find any alternative model to be better, including one with a threshold. While epidemiology is not capable of detecting risks in the low dose domain, under say 10,000–20,000 millirem, there are cellular experiments and theoretical reasoning that support a linear response."
	The assertion that there is still significant public health concern for adverse health effects below a lifetime whole body dose of 5000 mrem needs its basis stated explicitly. A report entitled, "Bridging Radiation Policy and Science", from an international conference held in December 1999, (see the citation for Mossman et al. 2000, listed at the top of p.155 of the draft White Oak Creek PHA) states that the lowest dose at which a statistically significant radiation risk has been shown is about 10,000 mrem. The lowest dose from whole body irradiation at which a statistically significant relative risk has been established is less than 10 mGy (less than one rad). This does not mean, however, that health effects from doses below 10 mGy are not to be observed or expected to occur. See recent publications and presentations by Dr. David Brenner from Cornell University. He and Mossman debated each other last summer on this very topic. Mossman lost resoundly.	Thank your for your comment. An extended abstract for the referenced debate and follow-up lecture between Drs. David Brenner and Kenneth Mossman titled *Do Radiation Doses Below 1 cGy Increase Cancer Risks?* is available at http://dceg.cancer.gov/pdfs/travis1636952005.pdf. ATSDR contacted Dr. Mossman who, contrary to this commenter's opinion, stated that the claim that he lost "resoundly" was not shared by everyone attending the American Statistical Association Conference on Radiation and Health meeting (June 2004), including representatives from EPA. As Dr. Mossman stated to ATSDR, "I don't argue that the risk is zero; my view is that the risk is too small to measure reliably." According to the abstract, Dr. Mossman finds that "Direct measurement of risks at very small radiation doses is difficult because of limitations of epidemiological studies to detect risk. Accordingly, risks are estimated by extrapolating from direct observations made at high doses to the low-dose region using predictive theories such as the linear, no-threshold theory. However, estimates are highly uncertain because the required dose extrapolation is

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		very large." "Estimating low-dose risks using very large dose extrapolations strains the credibility of risk assessment. Accordingly, numbers of cancer deaths due to low levels of radiation exposure must be considered speculative; risk estimates at low doses have great uncertainties because they are derived theoretically." "The possibility that there may be no health risks from radiation doses comparable to natural background radiation levels cannot be ruled out; at low doses and dose rates, the lower limit of the range of statistical uncertainty includes zero." Therefore, Dr. Mossman's position on this matter is not in line with the commenter's implication that "health effects from doses below 10mGy are not to be observed or expected to occur." Given the abstract and Dr. Mossman's statement to ATSDR above, his position is that "if risks exist below 1 cGy, they are too small to measure reliably." Also, please refer to the summary of the debate, which states that "the lowest radiation dose associated with statistically significant increased risk remains controversial. Epidemiological studies are not powerful enough to detect risks at doses approximating 1 cGy in the general population because the necessary large populations are not available…although unequivocal evidence of risk is unavailable at very low doses, this does not mean that increased risks do or do not exist. That said, however, if a risk below 1 cGy is present, it is very small for any given individual—the controversial issue being the risk to a large population potentially exposed to these small risks." Furthermore, another radiation expert conveyed to ATSDR that much difficulty is involved in understanding the concept of extrapolated risk "such as 5 extra cancer deaths over a lifetime per 100 million persons exposed to 1 μSv (0.1 mrem)." For example, this expert stated, "It would take more than the world's population of 5 billion persons to be exposed to one gamma ray for even a single excess cancer death to occur. The probability of the event is of the order of one in a million billion, i.e., less than one in a trillion. This probability might be placed in context with the fact that each hour over 200 million gamma rays pass through our bodies as the result of exposure from naturally occurring radiation in the soil, building materials, food commodities, and from cosmic rays." Therefore, ATSDR—as well as other experts in the field of radiation epidemiology and radiation health—believe that it is inappropriate, misleading, and not good science to apply a tiny dose far below the level for which health effects have been observed to a large population and compute or assign predicted numbers of excess cancers that "could" occur over decades.

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28	Page 8, lines 20–21: The implication that a dose of 390,000 to 620,000 mrem is associated with measurable bone cancer in radium dial workers is incorrect. The analysis by Thomas (1995) (see discussion in Annex G of the UNSCEAR 2000 report) indicated that this dose range represented a *threshold* for tumor induction, i.e., at or below which no tumors were observed. He further proposed a rounded value of 10 Gy (1,000,000 mrem) as a "practical threshold" below which there should be little cause for concern. [Although the ATSDR cites the report by Rowland (1994) as the source of its information, the follow-up analysis by Thomas postdates that of Rowland, and was cited by UNSCEAR.] The ATSDR's use of epidemiologically derived "Comparison Values" is reportedly not consistent with its practice in other PHAs. One such "value," a dose range of 390,000 to 620,000 mrem cited for red bone marrow, is not technically justifiable. Most concerning to me is the cancer comparison value that ATSDR has given for bone and red bone marrow of 390,000 to 600,000 mrem (3.9 to 6.0 Gy). This cancer comparison dose value is inconsistent with the scientific literature of epidemiological studies of human populations (workers including members of the public) exposed to ionizing radiation. For radiogenic leukemia, the ATSDR cancer comparison value of 390,000 mrem to 600,000 mrem to the red bone marrow (equivalent to organ doses of 390 rem to 600 rem) is neither protective of public health nor is it commensurate with a value below which the risk of cancer can be considered to be negligible. The cancer CV for radiogenic leukemias of 390,000 to 620,000 mrem to the bone marrow is far above the lower limits of statistical significance of an observed relative risk in human cohorts. A more thorough review of the literature would show that statistically significant relative risks of leukemia have been reported in public and worker cohorts exposed to radiation at doses ranging from below 1,000 mrem to 40,000 mrem, which is a factor of about 10 to 400 below that given by ATSDR as a cancer CV for the red bone marrow. In his opinion, it was misleading the public by promulgating these numbers and implying that there is no public health concern below them. In his opinion, these numbers were not scientifically defensible or commensurate with standard practice in radiation health assessment.	As discussed in the public health assessment, ATSDR's use of the cancer comparison value for bone surface and red bone marrow is based on reviews of radium dial painters. The values used are derived from analyses of radium dial painter remains (autopsy), tissue analysis, direct measurements of absorbed dose, and observations. The doses we cite are typically considered a threshold dose for the appearance of bone sarcomas associated with alpha particles. Therefore, we believe their use is appropriate. ATSDR has also consulted with the former director of the United States Uranium and Transuranium Registry who agreed with the agency's use of these numbers. Our selection of the dose was derived from several sources that evaluated the radiation dose to humans involved in the radium dial painting during the early part of the 20th century. One advantage of these studies was the ability to measure the amount of radium in the bone—the major organ where the radium was stored. Moreover, one could determine the radiation dose to the skeleton and a correlation of the dose to clinically observed skeletal damage. At the time the radium studies ended in 1993, about 1,000 of the estimated 2,400 dial painters were still alive. The radium dial studies have shown that following the ingestion of less than 100 microcuries of radium, the probability of developing a bone sarcoma is very low. The reports also state, "no symptoms from internal radium have been recognized at levels lower than those associated with radium-induced malignancy." Even at intakes of about 1,000 times greater than background, there does not appear to be any or little evidence of damage to the skeleton. Based on Federal Guidance Report 13, the ingestion of 100 microcuries of Ra-226 imparts a dose to the red bone marrow of 1,500 rem for a 15-year-old and 320 rem for an adult. The dose to the bone surface is 35,000 rem and 4,610 rem for a 15-year-old and an adult, respectively. This is in line with the ATSDR comparison value used in this public health assessment. The Biological Effects of Ionizing Radiation (BEIR) V study evaluated various studies of x-rays or gamma radiation to the bone. In one study the BEIR V committee stated that no bone sarcomas were found when the dose to bone was less than 30 Gray (Gy, or 3,000 rads) over a 3-week period. Nonetheless, other studies were either inconclusive or showed large uncertainties. Thus, the BEIR V committee stated that studies of alpha emitters such as radium intake studies should be used to evaluate the induction of radiation-induced bone cancer. From a risk perspective, BEIR V stated that the risk of bone sarcoma per person was on the order of 1.4×10^{-6} per rad with the peak occurrence at 8 years following exposure.

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	A critic of the document has noted that "ATSDR uses a 'cancer comparison value' of 390,000 mrem for the irradiation of the red bone marrow. This rather high dose level is based on the limits of epidemiological detection in the cohort of radium dial painters. The implication is that doses at or below 390 rem to the red bone marrow are of no concern for public health. Such a conclusion is … not consistent with mainstream science, nor is it consistent with how ATSDR evaluates minimum risk levels for other known human carcinogens." Please address this criticism and explain why this dose level was used.	We agree that studies are available showing damage at doses lower than these. We are, however, applying our screening value as a *long-term* screen. Many of the studies you may be referring to involve *acute* or short-term exposures. There is much disagreement in the scientific community as to the methods used to adjust long-term exposures to short-term exposures. Also, as a reminder, the studies mentioned by the commenter are retrospective, whole-body exposures based on cohort or case-controlled studies with poor dosimetry. By contrast, the radium dial studies are based on analyses of radium dial painter remains (autopsy), tissue analysis, direct measurements of absorbed dose, and observations, and these studies are not affected by weighting factors (rad versus rem). There are subtle differences between ATSDR's process of evaluating chemicals and radiation, such as dose to individual organs, age-specific dose coefficients, and other metabolic differences as discussed in several International Commission on Radiological Protection (ICRP) publications. It is of interest to note that in its 1989 Report 96 (titled: *Comparative Carcinogenicity of Ionizing Radiation and Chemicals*), the National Council on Radiation Protection and Measurements (NCRP) stated that less than 30 chemicals were known to be cancer inducing in man and of those, in most it was not possible to define a dose-incidence relationship except generally. Also, there is much more uncertainty in chemical metabolism, additive or synergistic effects between or among chemicals, potency, and dosimetry than in radiation evaluations. The NCRP stated that risk assessment for chemicals is "generally more uncertain than risk assessments for radiation." Because of these statements by the NCRP, ATSDR does not, in the true sense of the comment, evaluate radiation in the similar manner as the agency evaluates chemicals.
	Page 115: The ATSDR report states: "Doses on the order of 25,000 mrem are believed to affect the formation of blood cells and may induce leukemia." ATSDR also states on page 115 that leukemia in A-bomb survivors was observed for doses as low as 50,000 mrem. However, they use a dose limit for bone of 390,000 to 620,000 mrem as obtained from the radium dial workers. The difference between the lowest doses producing a statistically significant relative risk from the A-bomb Survivors and those from the radium dial workers is only due to the difference in exposure rate (acute vs. chronic exposure). The radium dial painters were adults at the time of exposure, and the study included a smaller number of people than the A-bomb survivors. Thus, we do not believe that the CVs derived from the radium dial workers are realistic, or representative for the population exposed downstream of White Oak Creek.	It is true there is a major difference in the values cited in the case of acute versus chronic exposure. What is not clearly evident is that the critical organs for each exposure scenario are different: bone marrow (acute) and bone surface (chronic). The atomic bomb survivor studies only a few years following the exposure identified leukemia as the major cancer observed. Also, the atomic bomb survivor cancer rates have been used to estimate both acute and chronic cancer risks associated with radiation exposure. Use of the comparison value for bone cancer is appropriate as the values used for bone surface and red bone marrow doses are based on autopsy and actual bone uptake, measurements, and observations.
	P. 111. The comparison values listed on p. 111 for bone surface and red bone marrow look quite high. All the comparison values listed on p. 111,	As mentioned, the values used for bone surface and red bone marrow doses are based on autopsy and actual bone uptake, measurements, and observations. Therefore, we believe

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	except the one for a whole body dose, are apparently single organ doses. These can and should be checked for reasonableness and consistency by using the weighting factors listed on p .66 to calculate the corresponding effective whole body doses, which should all be less than 5000 mrem. The comparison values for bone surface and red bone marrow fail this test. Therefore, these values need more scrutiny.	their use is appropriate. In the public health assessment, the use of weighting factors as described by the International Commission on Radiological Protection (ICRP) is to ensure equal detriment to all organs of exposure; that is, when evaluating future exposures, weighting factors are a type of risk analysis and probability exercise. The dose coefficients, tissue weighting factors, and radiation weighting factors are based on statistical estimates of the energy absorbed, risks of cancer or other deleterious effects, and the relative harm or damage caused by a specific type of radiation—alpha, beta, or gamma. These units are combined to give an estimate of the dose coefficient. When insufficient information is given, these values are used to project or predict a radiation dose. In the case of the dose comparison value used by ATSDR for the dose to the bone, however, we relied on human data as discussed in the next paragraph.
	ATSDR has changed from its past proclamation that a cancer CV is legitimate at 5,000 mrem over 70 years to using a CV of 390,000–620,000 mrem for red bone marrow based on apparent limits of epidemiologic detection in radium dial painters. In his opinion, it is well known that the radium dial painters consisted of a statistically low power cohort, and a statistically significant dose response is unlikely with low power epidemiologic studies. The ATSDR has produced lifetime cumulative doses, defined as cancer Comparison Values (CVs) that are inappropriate for the evaluation of the health risk to individuals who may have been exposed to past, present, and future releases of radioactive substances from White Oak Creek. These cancer CVs for radiation exposure, which range from 5,000 mrem to 620,000 mrem, are associated with high relative and absolute risks of excess cancer incidence. With the exception of the CV used for the red bone marrow, they are approximately equal to the lowest published dose at which a *statistically significant* relative risk has been reported from epidemiological investigations in human cohorts. They are not, however, dose levels below which "no health effects have been observed or expected to occur."	For the evaluation of bone sarcoma, ATSDR used data derived from human observation of the radium dial painters via autopsy, bone analyses, and other direct observation studies. The doses we cite are typically considered a threshold dose for the appearance of bone sarcomas associated with alpha particles. Furthermore, the commenter's statement that "ATSDR has changed from its past proclamation that a cancer CV is legitimate at 5,000 mrem over 70 years to using a CV of 390,000–620,000 mrem for red bone marrow" is incorrect and indicates a misunderstanding of ATSDR's radiogenic cancer comparison value. Our radiogenic cancer comparison value of 5,000 millirem over 70 years is used for comparing estimated whole-body, lifetime committed effective doses, whereas the CV of 390,000–620,000 millirem in this public health assessment compares estimated committed equivalent doses over a lifetime for both bone and red bone marrow. As noted, the radium dial painters are actual measured doses as seen in the expression of their doses (rads). ATSDR has also consulted with the former director of the United States Uranium and Transuranium Registry who agreed with ATSDR's use of these numbers.
	He referred to Table 2 [of the summary document], reading that the implication was that the dose for red bone marrow is "less than 1,100 mrem." If reviewing the dose estimates, the confidence intervals would overlap and exceed 5,000 mrem. He expressed his belief that only the 50th percentile of the uncertainty analysis is being used and the remaining probability distribution is being ignored. In his opinion, this was censoring	ATSDR uses the central values—not the upper-bound value of the dose estimates—because these provide the most realistic doses for potential exposures to radionuclides in the Clinch River and the Lower Watts Bar Reservoir. The use of the upper-bound value artificially increases the risk as the calculated uncertainty in many cases is at least an order of magnitude or greater than the 50th percentile value. Thus ATSDR used the 50th percentile (central) value from the Task 4 of the Tennessee Department of Health's Reports of the

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	important information and was not representative of the less than value. It implies that a radiation dose to the red bone marrow of "less than 1,100 mrem" is of no concern for public health, yet the uncertainty analysis produced by our dose reconstruction indicates the potential for red bone marrow doses to have been much higher than this value.	Oak Ridge Dose Reconstruction (Task 4 report). The values calculated by ATSDR are in line and agree with the Task 4 values, even though the methods of analyses were different (see the response to comment 12 for more information on how these different methods were used to develop the same basic conclusions). Central estimates are used because they describe the risk or dose for a typical, realistic individual. When considering central estimates, half of the potential doses will fall above and half will fall below the estimate. Therefore, an individual's actual dose would most likely be closer to the central value than near the high or low end of the range of dose estimates. In fact, ATSDR's external reviewers who evaluated documents associated with the Oak Ridge Dose Reconstruction recommended emphasizing the central estimate rather than the upper and lower bounds of the dose distribution. When using the central estimates, all estimated doses in this public health assessment were below levels shown to cause observable and tolerable effects.
	Although the epidemiological study of radium dial painters which was used to generate the Comparison Value for red bone marrow did not indicate an excess of leukemias attributable to radiation exposure, it is inapplicable to the exposures that resulted from the past releases from White Oak Creek and the contamination of the Clinch River and Lower Watts Bar Reservoir. Exposures resulted largely from whole body exposure to Cs-137 gamma radiation, with an additional contribution from Sr-90 beta particles. The statistical power to detect leukemias in the radium dial painters was relatively low, and there are serious unanswered technical questions about the relative biological effectiveness of exposures from radium because of non-uniform irradiation of the bone marrow and a potential protective effect of irradiated marrow (Spiers and Vaughan 1989; Stebbings 1998).	We agree that the bone marrow alpha particle dose should not be used to estimate leukemia, and we did not use this as a comparison value. For annual whole-body doses, we used the annual screening dose limit of 100 millirem per year recommended for the public by the International Commission on Radiological Protection (ICRP), the National Council on Radiation Protection and Measurements (NCRP), and the U.S. Nuclear Regulatory Commission (NRC), as well as ATSDR's minimal risk level (MRL). ATSDR compared lifetime doses to the agency's radiogenic cancer comparison value of 5,000 mrem over 70 years, which is based on peer-reviewed literature and other documents developed to review the health effects of ionizing radiation. These values, used as screening tools during the public health assessment process, are levels below which adverse health effects are not expected to occur. Because the screening indicated that past or current doses did not exceed our comparison values, further in-depth health evaluation was determined unnecessary.
	Studies of the Japanese atomic bomb survivors and a variety of other groups who were exposed to external irradiation or to a mixture of external and internal radiation (e.g., the Techa River population) have shown that there are significant excess relative risks of leukemia at doses of 1 Sv (100,000 mrem) or less (Little et al. 1999; UNSCEAR 2000). The leukemia risks (either incidence or mortality) in the A-bomb survivors were significantly elevated at all doses $\geq$400 mSv (400,000 mrem, UNSCEAR 2000). Estimated risks for leukemia induction based on the international study of combined cohorts of radiation workers do not suggest that current estimates of leukemia risks at low levels of exposure based on the A-bomb survivor data are appreciably in error (Cardis et al. 2001). Another set of	As noted, the radium dial painter values are actual measured doses as seen in the expression of their doses (rads). The values cited in this comment are not absorbed doses, but are calculated estimated doses expressed as effective doses since the unit Sievert is given. If these were measured doses the units would have been Grays. ATSDR has also consulted with the former director of the United States Uranium and Transuranium Registry who agreed with the agency's use of these numbers.

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	information on leukemia risks at low doses is that resulting from exposures to children and young adults in Utah who were aged 0–19 years when exposed to fallout from the Nevada Test Site (Stevens et al.1990; UNSCEAR 1994). Significant excess risks (defined on the basis of 95% confidence levels) were observed in the groups who received 6.0–30 mGy (600 to 30,000 mrem) to the bone marrow.	
29	In my comments submitted on the ATSDR PHA on Radionuclides Released from White Oak Creek to Clinch River, I have remarked that the cancer Comparison Values for radiation that have been produced by ATSDR for PHAs at Oak Ridge are inconsistent with ATSDR practices for other known human carcinogens provided. These are presented in the ATSDR PHA Guidance Manual and ATSDR Cancer Policy Framework that clearly document the policy of ATSDR regarding other carcinogens. The opinion that there is no need for communication of risk to the public at levels below the ATSDR cancer comparison values is certainly a topic that should be subjected to community debate. However, the conclusion that radiogenic cancer risk is inherently negligible at doses below the ATSDR cancer comparison values is inconsistent with mainstream science in radiation protection, radiation epidemiology, and radiation biology, and it is inconsistent with the manner in which ATSDR evaluates the risk to public health from exposures to other toxic substances. The issue regarding ATSDR's review of dose levels defining statistically significant relative risks for radiogenic cancers and the use of these dose levels as "cancer comparison values," is extremely important. This is coupled with the concern that ATSDR has adopted an administrative policy to not acknowledge nor discuss the range of risks of past exposures below these dose levels. These concerns are not new. They have been raised by many others in the past. Not only are the cancer comparison values (in the PHA) incorrect, but the dose levels are high. It's misleading to the public to imply that there is no concern for public health. In his opinion, the CVs being used were not only conceptually incorrect, but the numbers were above dose levels where there has been statistically significant confirmation of radiogenic cancer in populations. He expressed	In Section III. H. of ATSDR's Cancer Policy Framework, the agency recognizes that, at present, no single generally applicable procedure for exposure assessment is available. Therefore exposures to carcinogens must be assessed on a case-by-case or context-specific basis. While the need for, and reliance on, models and default assumptions is acknowledged, ATSDR strongly encourages the use of applicable empirical data (including ranges) in exposure assessment. Also, in Section IV. A, subsections 1 and 2, the position of ATSDR is interpreted as being related to chemical carcinogens and is not related to radiological contamination. Following the ATSDR Cancer Framework Policy, ATSDR does not perform risk assessments. The agency, however, does recognize the importance of the U.S. Environmental Protection Agency's (EPA) risk assessment and risk analysis to determine whether levels of chemicals at hazardous waste sites pose an unacceptable risk as defined by regulatory standards and requirements and to help regulatory officials make decisions in support of cleanup strategies that will ensure overall protection of human health and the environment. ATSDR acknowledges that conservative safety margins are built into EPA risk assessments and that these assessments do not measure the actual health effects that hazardous chemicals at a site have on people. For additional information, please see the response to comment 44 regarding the intentional differences between a public health assessment and a risk assessment and review the framework policy that can be found at http://www.atsdr.cdc.gov/cancer.html. In this public health assessment ATSDR compares annual whole-body doses to the 100 mrem/year dose limit of the International Commission on Radiological Protection (ICRP), the National Council on Radiation Protection and Measurements (NCRP), and the U.S. Nuclear Regulatory Commission (NRC), as well as ATSDR's minimal risk level (MRL). ATSDR compares lifetime whole-body doses to the agency's radiogenic cancer comparison value of 5,000 mrem over 70 years, which is based on peer-reviewed literature and other documents developed to review the health effects of ionizing radiation. These values, used as screening tools during the public health assessment process, are levels below which adverse health effects are not expected to occur. If the screening indicates that past or current doses exceed our comparison values, then we would conduct further in-depth health evaluation.

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	his belief that statistical limits of epidemiologic detection should not be used as limits of concern. In his opinion, this violated the standard practice of radiation health assessment and environmental risk assessment, and inaccurately implied that there was no concern at levels below these cancer CVs. In his opinion, these CVs were in violation of any scientific knowledge of interaction of radiation and the ability of radiation to cause cancer in human and animal populations. He expressed his belief that this work was misleading, technically deficient, and inappropriate. I believe the values proposed as "cancer comparison values" are not consistent with proper evaluation of radiogenic cancer risk in exposed populations. I know of no other known human carcinogen for which ATSDR has chosen a dose level approximately equal to a lowest observed adverse health effect level (or lower limit of epidemiological detection) as a surrogate for a limit of public health concern. The use of the lowest observable adverse effects level as an equivalent for a safe or negligible level of exposure is in fact inconsistent with ATSDR policy and practices used for all potentially toxic substances including those attributable to non-cancer health endpoints and those that cause cancer. For other toxic substances, ATSDR applies a considerable margin of safety to the lowest observed adverse effects level before designating an exposure or dose level as being commensurate with a minimal public health risk. For radiation, however, ATSDR designates dose levels that are considered to be at or just below the limits of statistical significance in epidemiological studies as "cancer comparison values," and implies that there is no concern for public health at doses below these levels. I do not object to the reporting of radiation dose levels that are equivalent to epidemiological limits of statistical detection in specific exposed cohorts. This is appropriate information to convey to the general public, as long as the attendant risk of exposure to doses below these levels are also communicated. It's a totally different matter, however, to assert that such dose levels are equivalent to safe or negligible risk levels, and to ignore or censor information about the potential for risk at lower dose levels. For instance, in my recent reading of the ATSDR PHA for radiation released from X-10 to the Clinch River, I have discovered that ATSDR has issued "cancer comparison values" of 5000 mrem to the whole body and	When ATSDR developed its screening values for radiation exposures, safety margins were incorporated. The approach ATSDR uses to derive MRLs, such as those in the Toxicological Profile for Ionizing Radiation, was developed with the EPA. The screening value includes the use of a no observed adverse effect level (NOAEL) or a lowest observed adverse effect level (LOAEL) as well as three or more situation-specific uncertainty factors. When multiplied, these factors give a total uncertainty factor generally ranging from 1 to 1,000, based on the studies used. Furthermore, the ATSDR legislative authority, as discussed many times, limits ATSDR to evaluation of exposures based on observable and tolerable adverse health effects. If adverse health effects are not observed in an epidemiological study, then the doses used in the study should be considered tolerable. ATSDR's radiogenic comparison value of 5,000 millirem over 70 years incorporates the linear no-threshold (LNT) model for evaluating public health hazards associated with exposure to radiation. It assumes a total lifetime dose (70 years of exposure) above background that is considered safe in terms of cancer induction. In addition to the LNT model, ATSDR also incorporates a margin-of-dose (MOD) approach into this comparison value. During an evaluation, if ATSDR determines that further investigation is needed, scientific literature associated with radiological doses and dose estimates, particularly those related to adverse health effects, is reviewed. ATSDR then compares the dose estimates from scientific literature to site-specific dose estimates. Thus, ATSDR uses the LNT model to determine when a more detailed site-specific evaluation is necessary, and uses the MOD approach to develop realistic information for communities regarding what is known and unknown about radiation levels at a particular site. An independent expert panel convened to review ATSDR's site-specific approaches used to evaluate past, current, and future radiation risks to communities surrounding the Oak Ridge Reservation concluded that this combination of approaches (LNT and MOD) is appropriate for ATSDR to use to determine radiation levels at which health effects actually occur. The panel found that ATSDR's use of the MRL of 100 millirem and radiogenic cancer comparison value of 5,000 millirem were appropriate screening values. If extrapolated over 70 years assuming constant exposure, the radiogenic cancer comparison value dose estimate would be about 71 millirem per year—a level the panel determined to be protective of public health in terms of cancer and noncancer risks. The panel also concluded that ATSDR's approach considers evidence for both individual organs and whole-body doses (effective doses), noting that a whole-body dose could not be developed without accounting for doses to single organs. Further, the panel determined that ATSDR's method of distinguishing dose levels from risk levels was acceptable because ATSDR incorporated risk and LNT explicitly and implicitly when calculating doses. In the words of one peer reviewer regarding ATSDR's radiogenic cancer comparison value,

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	lower large intestine, 9,000 mrem for the skin, 10,000 mrem for the breast, and 390,000 to 620,000 mrem to the bone surface and red bone marrow. These values are not appropriate for use as safe or negligible risk levels for exposures in human populations to ionizing radiation. This is most certainly the case for radiogenic leukemia, which is manifested through irradiation of the red bone marrow. The fact that such high dose cancer comparison values have been officially released for public communication by ATSDR is a matter that I find most troubling, both personally and professionally. When I evaluate the relative risk associated with this dose comparison value, I find the risk of radiogenic cancer to be extremely high. Yet, ATSDR is implying that doses at or below this level are inconsequential.	"The general consensus is that the linear non-threshold hypothesis is scientifically reasonable for the purpose of radiation protection. The recent NCRP comprehensive review and UNSCEAR [United Nations Scientific Committee on the Effects of Atomic Radiation] evaluations do not find any alternative model to be better, including one with a threshold. While epidemiology is not capable of detecting risks in the low dose domain, under say 10,000–20,000 millirem, there are cellular experiments and theoretical reasoning that support a linear response." Also, in this public health assessment ATSDR uses different comparison values depending on the organs and tissues being evaluated. While the cancer comparison value of 5,000 mrem over 70 years is used to compare effective whole-body doses over a lifetime and the 100 mrem/year is used to compare annual whole-body doses, these organ comparison values (discussed in detail below) were used to screen committed equivalent doses to organs over a lifetime. A comparison value of 390,000–620,000 millirem was used to compare estimated committed equivalent doses over a lifetime for bone surface and red bone marrow. ATSDR's use of the cancer comparison value for bone surface and red bone marrow, as discussed in the public health assessment, is based on reviews of radium dial painters. The values used are based on analyses of radium dial painter remains (autopsy), tissue analysis, and direct measurements of absorbed dose, and observations. The doses we cite are typically considered a threshold dose for the appearance of bone sarcomas associated with alpha particles. Therefore, we believe their use is appropriate. ATSDR has also consulted with the former director of the United States Uranium and Transuranium Registry who agreed with the agency's use of these numbers. Our selection of the dose was derived from several sources that evaluated the radiation dose to humans involved in the radium dial painting during the early part of the 20th century. One advantage of these studies was the ability to measure the amount of radium in the bone—the major organ where the radium was stored. Moreover, one could determine the radiation dose to the skeleton and a correlation of the dose to clinically observed damage to the skeleton. At the time the radium studies ended in 1993, about 1,000 of the estimated 2,400 dial painters were still alive. The radium dial studies have shown that following the ingestion of less than 100 microcuries of radium, the probability of developing a bone sarcoma is very low. The reports also state that "no symptoms from internal radium have been recognized at levels lower than those associated with radium-induced malignancy." Even at intakes of about 1,000 times greater than background, there appears to be little or no evidence of damage to the skeleton. Based on Federal Guidance Report 13, the ingestion of 100 microcuries of Ra-

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		226 imparts a dose to the red bone marrow of 1,500 rem for a 15-year-old and 320 rem for an adult. The dose to the bone surface is 35,000 rem and 4,610 rem for a 15-year-old and an adult, respectively. This is in-line with the ATSDR cancer comparison value being used in this public health assessment. The Biological Effects of Ionizing Radiation (BEIR) V study evaluated various studies of x-rays or gamma radiation to the bone. In one study, the BEIR V committee stated that no bone sarcomas were found when the dose to bone was less than 30 Gy (3,000 rads) over a 3-week period. Nonetheless, other studies were either inconclusive or showed large uncertainties. Thus, BEIR V stated that studies of alpha emitters such as radium intake studies should be used to evaluate the induction of radiation-induced bone cancer. From a risk perspective, BEIR V stated that the risk of bone sarcoma per person was on the order of 1.4×10^{-6} per rad, with the peak occurrence at 8 years following exposure. For evaluating estimated committed, equivalent, lifetime doses to the breast, ATSDR used a comparison value of 10,000 mrem over a lifetime. This value (reported in Schull's 1995 *Effects of Atomic Radiation: A Half-Century of Studies from Hiroshima and Nagasaki*) is based on an investigation focusing on a sample of women from the Life Span Study—a Radiation Effects Research Foundation program investigating the long-term effects of atomic bomb radiation on cancer incidence and causes of death. On the basis of an investigation focusing on women in the Life Span Study, women who were irradiated before 20 years of age experienced the highest rates of radiation-related breast cancer when receiving a dose of at least 0.10 Gy (10 rad or 10,000 mrem) of radiation. To evaluate estimated committed equivalent lifetime doses to the skin, ATSDR used a comparison value of 9,000 mrem over a lifetime. This value is based on the BEIR V report (titled *Biological Effects of Ionizing Radiation*) that evaluated potentially the most extensive study of radiation-induced skin cancer. In 1990, the National Research Council reviewed and evaluated the findings presented in BEIR V on the relationship between skin cancer and radiation and presented its findings in a 1990 report titled *Health Effects of Exposure to Low Levels of Ionizing Radiation*. The study involved investigating 2,226 individuals who had received radiation to the scalp for the treatment of ringworm during childhood. On average, these persons were studied for over 25 years. Basal cell carcinomas of the skin appeared in 41 of the 2,226 exposed individuals. These carcinomas began to appear after about 20 years of exposure. Instead of concentrating in the most heavily irradiated areas of the scalp, most of the tumors tended to appear at the margins of the scalp and in nearby areas of skin that had not been covered by clothing or hair. An excess of skin cancers was identified on the neck and cheek even though doses to the cheeks were approximately only 12 rad (12 rem or 12,000 mrem) and

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		doses to the neck were only 9 rad (9 rem or 9,000 mrem). In the ICRP's Publication 59 (1991), the agency stated, "Although it has traditionally been thought that there was little if any risk of skin cancer below 10 Gy [1,000 rad or 1,000,000 mrem], there are now several sets of data indicating excess skin cancer following doses of a few grays [a few hundred rad], with one study suggesting risk below 1 Gy [100 rad or 100,000 mrem]. The evidence does not indicate that the risk per unit dose is greater at higher doses than at lower [doses]." Therefore, the value of 9,000 mrem used as a comparison value for committed equivalent lifetime doses to the skin is based on absorbed dose and direct observation of individuals who received radiation of the scalp. This is the lowest reported dose where adverse effects have been observed following irradiation of the skin and significantly below dose levels reported by the ICRP as having resulted in health effects. For evaluating estimated committed equivalent lifetime doses to the lower large intestine, ATSDR used the radiogenic cancer comparison value of 5,000 mrem over a lifetime in the PHA. ATSDR could not locate a reliable comparison value to estimate a dose to the lower large intestine so ATSDR used the whole-body CV of 5,000 millirem over 70 years. We believe this is appropriate for the following reason. In general, the faster a cell system divides, the more sensitive that system is to the effects of radiation. The intestinal tract cell lining divides rapidly; the blood cells, especially the red blood cells, divide fastest (estimated production of RBC is 2.5 million per second). Following an acute radiation exposure to humans resulting in a dose of about 100 rads, the gastrointestinal tract begins to show damage. The dose of 100 rads agrees with the single dose to mouse intestinal cells of 130 rads. In humans, however, the Centers for Disease Control and Prevention (CDC) reports that symptoms may not appear until a dose of 600 rads has been received. The full expression of damage may require up to 1000 rads. And the dose of 600 rads is about 120 times higher than the estimated ATSDR CV for the large intestine. Therefore we believe the use of 5,000 millirem over 70 years is justified.
30	The NAS/NRC has recently recommended the use of the NIH-Interactive Radioepidemiological Program (IREP) program for estimating the attributable risk (or assigned share) for individuals diagnosed with disease who were exposed in the past to radioactivity released from the testing of nuclear weapons who should be evaluated for medical screening and compensation. Until such time as the publication of BEIR VII is released to the public, I believe the NIH-IREP program is the most thorough quantitative evaluation of the uncertainty in radiogenic cancer risk currently	In 1985, a working group for the National Institutes of Health (NIH) initially created the radioepidemiological tables the commenter references. The tables, updated in 2003, are used by the Department of Veterans Affairs as a reference for estimating the probability of causation for **workers** with cancer who had been exposed to ionizing radiation. The Department of Labor uses a version of the Interactive Radioepidemiological Program (IREP), referred to as the National Institute for Occupational Safety and Health (NIOSH)-IREP, to address workers under the Energy Employees' Occupational Illness Compensation Program Act (EEOICPA). The NIOSH-IREP, most recently updated in 2006, was created to evaluate the probability of causation associated with radiation and risks specific to energy

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	available. In current radiation compensation programs administered by the Department of Veterans Affairs and the Dept. of Labor, the value of the Probability of Causation/Assigned Share (PC/AS) used for the adjudication of claims is the upper 99th percentile of the probability distribution of PC. If a DOE worker had cancer, it would be compensable at these dose levels. He knew this because his company developed the probability of causation and radio-epidemiological tables being used for adjudicating claims by the Department of Labor and the Department of Veteran Affairs. He expressed his belief that these were high doses, which were not commensurate with levels below which there should be no health concern. To clarify a statement that exposure rates in this document are at a level that would be compensable under the Energy Employees Occupational Illness Compensation Program Act (EEOICPA) without any other exposures, he answered that the cancer CVs would be compensable, and the upper bounds of exposure that exceeded the 5,000 mrem whole-body dose for some cancers and some age groups would be compensable. The current rules extend only to workers, not to the general public. He expressed his belief that this was particularly true considering the red bone marrow cancer CV (390,000–620,000 mrem), which in his opinion, was high and not appropriate to use. He expressed surprise that this had passed through the extensive review process, and questioned whether ORRHES might not have the necessary technical expertise to review these documents.	employees for the purpose of adjudicating claims. Please note that these radioepidemiological tables are **only** used for litigation purposes and for the adjudication of claims for workers. This means that worker exposures are evaluated from a legal perspective—this is not a health-based assessment. As mentioned on several occasions, ATSDR's congressional mandate does not allow an evaluation of worker exposures. Therefore, this public health assessment evaluates **off-site exposures** to White Oak Creek radionuclide releases for downstream residents and others who use or live along the Clinch River and the Lower Watts Bar Reservoir only. It does not evaluate any exposures potentially occurring onsite at the reservation, including exposures to workers and other individuals who may contact contaminants while at the ORR. ATSDR does not prepare any public health assessments to evaluate on-site worker exposures. Other agencies are responsible for evaluating worker exposures that occur on site. ATSDR uses the public health assessment process to evaluate the public health implications of exposure to environmental contamination and to identify the appropriate public health actions for particular communities. ATSDR health physicists conduct a health effects evaluation by carefully examining site-specific exposure conditions about actual or likely exposures; conducting a critical review of available radiological, medical, and epidemiologic information to ascertain the substance-specific toxicity characteristics (levels of significant human exposure); and comparing an estimate of the amount of radiological dose to which people might frequently encounter at a site to situations that have been associated with disease and injury. This health effects evaluation involves a balanced review and integration of site-related environmental data, site-specific exposure factors, and toxicological, radiological, epidemiologic, medical, and health outcome data to help determine whether exposure to contaminant levels might result in harmful effects. The goal of the health effects evaluation is to weigh the scientific evidence and keep site-specific doses in perspective when deciding whether harmful effects might be possible in the exposed population. The output is a qualitative description of whether doses are of sufficient nature and magnitude to trigger a public health action to limit, eliminate, or study further any potentially harmful exposures. The PHA presents conclusions about the actual existence and level of the health threat (if any) posed by a site. The White Oak Creek Radionuclide Releases PHA underwent several phases of review before its final release, including an internal ATSDR review, a data validation review by other agencies (i.e., DOE, EPA, and TDEC), an Oak Ridge Reservation Health Effects Subcommittee (ORRHES) review, an independent external peer review, and a public comment review. During the agency's internal review process, individuals within the agency who have the proper background (e.g., toxicology and health physics) carefully reviewed

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		the document for technical content and other aspects. After receiving comments from other agencies during the data validation review, ATSDR made changes to the document as appropriate. ORRHES members consisted of individuals with different expertise, backgrounds, interests, and geographic areas from communities surrounding the Oak Ridge Reservation. ORRHES included among its members technical experts in toxicology, health physics, medicine, geology, and other disciplines. ORRHES members carefully reviewed this PHA, discussed suggested editorial and technical changes among themselves, then submitted recommendations to ATSDR for changing the document. Through its external peer review process, ATSDR's Office of Science had three scientific experts review this public health assessment (see Appendix H for the peer reviewer comments and ATSDR's responses). The agency's peer review process allows an external and thorough evaluation of this PHA by experts in the field that this assessment covers: health physics. During the external review process, individuals not employed by ATSDR or the CDC independently reviewed this document and provided their unbiased, scientific opinions. Also, several times at public meetings, including work group and ORRHES meetings, ATSDR presented the data and information used in this public health assessment. In addition, during the public comment period, any member of the public can provide comments to ATSDR. These public comments, such as those presented within this appendix, are addressed for each public health assessment. ATSDR uses a multi-disciplinary approach for reviewing public health assessments; experts in toxicology, medicine, health physics, and other disciplines review our work. All peer reviewers approved of this assessment and found no major flaws that would invalidate ATSDR's conclusions and recommendations. In the words of one peer reviewer: "You [ATSDR] have done a good job under very difficult circumstances with a lot of unwanted publicity and carping. The science under the report is very good and the report is well written in a very good manner that is suitable for both an informed and interested public and the scientific community."
31	P. 111. The footnotes on pages 111, line 4-5 and 112, line 5-6 as well as the definition in the glossary on page A-7 are expressed as a double negative "unlikely and non-cancerous." Is there a more positive way to define MRL that will facilitate understanding? Perhaps, give an example in the glossary or context of the report that demonstrates what is meant by non-cancerous effects and how they are taken into consideration. Also, it may be helpful to refer the reader to the ATSDR web site to read the document on MRLs (http://www.atsdr.cdc.gov/mrls.html). [In that document it says "An MRL is an estimate of the daily human exposure to a hazardous substance that is likely to be without appreciable risk of adverse	Thank you for your comment. The definitions were changed in the footnotes for Tables 22 and 23, and in the glossary in Appendix A. "Unlikely" was changed to "likely to be without" as suggested. The term "noncancerous" is a standard term used by ATSDR and other agencies, and was retained throughout the document. Also, "noncancerous effects" was added to the glossary in Appendix A of the final PHA with the following definition: "Health effects or health endpoints other than cancer, such as cardiovascular disease or genetic effects, that result from exposure to a particular hazardous substance. ATSDR derives health guidelines for noncancerous effects, called minimal risk levels (MRLs), and compares exposure doses to these MRLs. Doses below

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	non cancer health effects over a specified duration of exposure."] Is the MRL more conservative (protective) than CVs that take into consideration cancer effects alone? What really distinguishes the MRL from the CVs from other sources?	MRLs are unlikely to cause noncancerous health effects; those above MRLs are evaluated further." Also, the Web site link was added to the footnotes of Tables 22 and 23 for readers who would like to see more information on MRLs. MRLs for radiation are estimates of daily human exposure to an amount of radiation that is likely to be without appreciable risk of adverse noncancer health effects. MRLs are screening tools used by public health professionals to determine which exposure situations require further evaluation. The chronic MRL for ionizing radiation is 100 mrem/year. This is consistent with the dose limits recommended for the public by the International Commission on Radiological Protection (ICRP), the National Council on Radiation Protection and Measurements (NCRP), and the U.S. Nuclear Regulatory Commission (NRC). Although the MRL is for noncancerous health effects, when deriving the MRL no studies were identified that did not result in cancer as the specific end point. In this public health assessment, ATSDR compares annual doses to the 100 -mrem/year dose limit of the ICRP, NCRP, and NRC, as well as ATSDR's MRL. ATSDR compares lifetime doses to the agency's radiogenic cancer comparison value of 5,000 mrem over 70 years, which is based on peer-reviewed literature and other documents developed to review the health effects of ionizing radiation. These values, used as screening tools during the public health assessment process, are levels below which adverse health effects are not expected to occur. If the screening indicates that past or current doses exceed these values, then we would conduct further in-depth health evaluation. When ATSDR developed its screening values for radiation exposures, safety margins were incorporated. The approach ATSDR uses to derive MRLs, such as those in the Toxicological Profile for Ionizing Radiation, was developed with the U.S. Environmental Protection Agency (EPA). The screening value includes the use of a no observed adverse effect level (NOAEL) or a lowest observed adverse effect level (LOAEL) as well as three or more situation-specific uncertainty factors. When multiplied, these factors give a total uncertainty factor generally ranging from 1 to 1,000, based on the studies used. Furthermore, the ATSDR legislative authority, as discussed many times, limits ATSDR to evaluate exposures based on observable and tolerable adverse health effects. If adverse health effects are not observed in an epidemiological study, then the doses used in the study should be considered tolerable. ATSDR's radiogenic comparison value of 5,000 millirem over 70 years incorporates the linear no-threshold (LNT) model for evaluating public health hazards associated with exposure to radiation. It assumes a total lifetime dose (70 years of exposure) above background that is considered safe in terms of cancer induction. In addition to the LNT model, ATSDR also incorporates a margin-of-dose (MOD) approach into this comparison value. During an evaluation, if ATSDR determines that further investigation is needed,

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		scientific literature associated with radiological doses and dose estimates, particularly those related to adverse health effects, is reviewed. ATSDR then compares the dose estimates from scientific literature to site-specific dose estimates. Thus, ATSDR uses the LNT model to determine when a more detailed site-specific evaluation is necessary, and uses the MOD approach to develop realistic information for communities regarding what is known and unknown about radiation levels at a particular site. An independent expert panel convened to review ATSDR's site-specific approaches used to evaluate past, current, and future radiation risks to communities surrounding the Oak Ridge Reservation concluded that this combination of approaches (LNT and MOD) is appropriate for ATSDR to use to determine radiation levels at which health effects actually occur. The panel found that ATSDR's use of the MRL of 100 millirem and radiogenic cancer comparison value of 5,000 millirem were appropriate screening values. If extrapolated over 70 years assuming constant exposure, the radiogenic cancer comparison value dose estimate would be about 71 millirem per year—a level the panel determined to be protective of public health in terms of cancer and noncancer risks. The panel also concluded that ATSDR's approach considers evidence for both individual organs and whole-body doses (effective doses), noting that a whole-body dose could not be developed without accounting for doses to single organs. Further, the panel determined that ATSDR's method of distinguishing dose levels from risk levels was acceptable: when calculating doses, ATSDR explicitly and implicitly incorporated risk and LNT. There are subtle differences in ATSDR's process of evaluating chemicals and radiation, such as dose to individual organs, age-specific dose coefficients, and other metabolic differences as discussed in several ICRP publications. Interestingly, in its 1989 NCRP Report 96 (titled: *Comparative Carcinogenicity of Ionizing Radiation and Chemicals*), the NCRP stated that less than 30 chemicals were known to be cancer inducing in man and of those, in most it was not possible to define a dose-incidence relationship except generally. Also, there is much more uncertainty in chemical metabolism, the possibility of additive or synergistic effects between or among chemicals, potency, and dosimetry than there is in radiation evaluations. The NCRP stated that risk assessment for chemicals is "generally more uncertain than risk assessments for radiation." Because of these statements by the NCRP, ATSDR does not, in the true sense of the comment, evaluate radiation in a similar manner to which it evaluates chemicals. More information about the ATSDR evaluation process can be found in ATSDR's Public Health Assessment Guidance Manual at http://www.atsdr.cdc.gov/HAC/PHAManual/toc.html or by contacting ATSDR at 1-888-42-ATSDR. An interactive program that provides an overview of the process ATSDR uses to evaluate whether people will be harmed by hazardous materials is available at

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		http://www.atsdr.cdc.gov/training/public-health-assessment-overview/html/index.html.
32	A rationale for the nature and level of the ATSDR dose criteria for public health purposes and especially how the resulting doses vary from the more conservative levels used by the Environmental Protection Agency and other environmental agencies to meet their regulatory responsibilities should be explained. The differences from the liberal National Institute for Occupational Safety and Health work place levels should also be explained. This addition should also attempt to make clear the various connotations of the terms, "zero" and "none" as applied to risk analysis and public exposures.	For this PHA, ATSDR added an appendix (Appendix F) to discuss risk terminology, radiation risk, and risk limits in detail. The appendix also explains the differences between ATSDR public health assessments and EPA risk assessments and shows the method for converting the doses in this PHA to risk numbers. Since ATSDR does not use risk to develop public health conclusions, such an appendix is not normally included in ATSDR's public health assessments. Please note that ATSDR does not base its public health conclusions on these risk numbers—they are presented in this PHA to provide detailed information on risk for the community. In addition, text was added to Section III. Evaluation of Environmental Contamination and Potential Exposure Pathways to explain the difference between dose and risk. Note further, however, that ATSDR does not discuss the National Institute for Occupational Safety and Health (NIOSH) work place levels. This public health assessment does not deal with worker exposures; it solely evaluates exposures for off-site communities.
33	The use of natural background radiation in some comparisons can also be misleading, because the risks from some components of background (e.g., radon) are not negligible. Indoor exposure to the decay products of radon are now known to be the second leading cause of lung cancer (Field 2001, 2003).	ATSDR agrees that radon should not be included in background unless directly comparing to radon levels. As the commenter points out, radon progeny contribute to lung dose and should not be mixed with whole-body dose. The natural range of background, not including radon, ranges from 80 mrem/year to 26,000 mrem/year (1). The nominal background dose from naturally occurring radiation in the contiguous United States is 100 mrem/year not including radon, but can range from 80 to about 1,000 mrem/year (2). No data suggest that radiation doses from background, excluding radon, have any deleterious effects. In fact, recent studies from the high background region in Ramsar, Iran, have shown protective effects up to doses of 10,000 mrem/year (3,4,5,6). The ATSDR MRL of 100 mrem/year is 0.38% of the range of natural background, not including radon. In addition, the Iowa Radon Study [Field RW, et al. (7)], referenced by the commenter, suffers from the following problems: 1. The total difference in lung cancer cases can be accounted for by natural variation among the cases (n=413). The natural variation in the number of cases is 20.3, while the 33% of cases exposed above 4 pCi/L and 28% of controls corresponds to 5% of 413 cases, or 20.6. 2. The study controls have an 11% higher rate of post-secondary education than the cases. Highest educational level has been strongly correlated to greater longevity and overall health. It does not appear that the odds ratios were corrected for educational level.

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		3. Due to the etiology of lung cancer, the mean life expectancy after diagnosis is around 5 years. Therefore, it is unreasonable to exclude cases that died during the 5-year study, but it may be reasonable to exclude only those cases for which the families disposed of the radon measuring devices before a radon measurement could be made. 4. If statistical significance can only be achieved by omitting cases that died during the study period, this might "imply" a protective effect from radon exposure. 5. A possible smoking and radon-exposure synergistic effect for developing lung cancer may not be accounted for in the analysis. Many of the uranium miner studies did not clearly identify the smoking status of those with lung cancer. The uranium miner studies appear only to show a relationship between radon exposure and cancer among the smokers and miners of unknown smoking status. 6. The cases had an ever-smoked rate of 86% versus a rate of 32% ever-smoked among the controls. The smoking correction is not defined, and the much higher rate of smoking among the cases is going to make the corrected odds ratio extremely sensitive to the smoking correction. 7. The intervals of cumulative radon exposure are made at strange, noninteger values and are not evenly spaced. No cases or controls were exposed to **zero** pCi/L of radon. There was a threshold of exposures. What was that value? 8. When confidence intervals are graphed for the odds ratios versus exposure categories, no clear dose response appears. A line requires at least two significant points to test for linearity, and the origin does not count. Overall, this study does not appear to demonstrate any statistically significant association or dose response between residential radon and lung cancer. (1) Ghiassi-nejad M, Mortazavi SM, Cameron JR, Niroomand-rad A, and Karam PA. 2002. Very high background radiation areas of Ramsar, Iran: preliminary biological studies. Health Phys 82(1):87–93; January. (2) Eisenbud M and Gesell T. 1997. Environmental radioactivity from natural, industrial, and military sources. Fourth edition. Pp. 198–200. San Diego, CA: Academic Press. (3) Masoomi JR, Mohammadi Sh, Amini M, and Ghiassi–Nejad M. 2006. High background radiation areas of Ramsar in Iran: evaluation of DNA damage by alkaline single cell gel electrophoresis (SCGE). J Environ Radioact 86(2):176–86.

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		(4) Ghiassi-Nejad M, Zakeri F, Assaei RG, and Kariminia A. 2004. Long–term immune and cytogenetic effects of high level natural radiation on Ramsar inhabitants in Iran. J Environ Radioact 74(1-3):107–16. (5) Ghiassi-Nejad M, Beitollahi MM, Asefi M, and Reza-Nejad F. 2003. Exposure to (226)Ra from consumption of vegetables in the high level natural radiation area of Ramsar-Iran. J Environ Radioact 66(3):215–25. (6) Saadat M. 2003. No change in sex ratio in Ramsar (north of Iran) with high background of radiation. Occup Environ Med 60(2):146–7; February. (7) Field RW, Steck DJ, Smith BJ et al. 2000. Residential radon gas exposure and lung cancer: The Iowa Radon Lung Cancer Study. Am J Epidemiol 151:1091–102.
34	The excess lifetime risk levels associated with ATSDR's cancer CVs for radiation are much higher than the risk levels ATSDR uses in its evaluation of other human carcinogens. For exposures to other human carcinogens, ATSDR usually considers risks in the range of one chance in ten thousand to one chance in one million to warrant more detailed investigation. For non-cancer producing toxic substances, ATSDR typically applies a series of safety factors to the lowest observed adverse effects level to derive an exposure level that can be considered to have a minimum risk. For exposure to radiation, the majority of scientific opinion is that there is no threshold dose below which the risk from exposure can be considered to be zero.	The risk range cited is the typical risk range the U.S. Environmental Protection Agency (EPA) uses in its evaluations of contaminants in the environment. Many of these evaluations may not necessarily be based on health, but entirely on risk assessments. The ATSDR Cancer Policy Framework, adopted in 1993, addresses many factors that must be evaluated in analyzing environmental exposures. ATSDR recognizes that, at present, no single generally applicable procedure for exposure assessment is available, and therefore exposures to carcinogens are best assessed on a case-by-case basis with an emphasis on prevention of exposure. The general consensus is that the linear nonthreshold hypothesis is scientifically reasonable for the purpose of *radiation protection.* The recent National Council on Radiation Protection and Measurement's (NCRP) comprehensive review (Report No. 136 titled *Evaluation of the Linear-Nonthreshold Dose-Response Model for Ionizing Radiation*) and the United Nations Scientific Committee on the Effects of Atomic Radiation's (UNSCEAR) evaluations did not find any alternative model to be better, including one with a threshold. The NCRP Report No. 136 also states that some adaptive responses may come into play at low doses, and these responses may result in the variations seen at low dose response levels. Further, the NCRP concluded "there is no conclusive evidence on which to reject the assumption of a linear-nonthreshold dose-response relationship for many of the risks attributable to low-level ionizing radiation although additional data are needed. However, while many, but not all, scientific data support this assumption, the probability of effects at low doses such as are received from natural background is so small that it may never be possible to prove or disprove the validity of the linear-nonthreshold assumption." Therefore, ATSDR does not deny the presence or absence of a linear response and the presence of risk at low levels. We evaluate public health implications based on the observations of adverse health impacts at low doses.

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35	The comparison of ATSDR dose estimates between past, present, and future exposures makes no sense. ATSDR states that the maximum cumulative dose from past releases was 278 mrem to the whole body, but that for present releases (1988 to the present time) the doses would be "less than 1,900 mrem for Lower Watts Bar Reservoir and 235 mrem for the Clinch River." This is absurd. There is no conceivable way that the doses from past releases are equal to or less than the doses from present releases. It appears as if two completely different methods of exposure analysis have been applied, one for past releases and another for present releases, with two completely different sets of assumptions. However, a comparison between the ATSDR estimates of present and future doses with those from the past indicate that widely different methods and assumptions have been used, giving the misleading impression that present and future exposures are of the same magnitude or larger than past exposures. This is clearly not the case.	ATSDR's evaluation of past exposures in this public health assessment is based on doses presented in Task 4 of the Tennessee Department of Health's Reports of the Oak Ridge Dose Reconstruction (Task 4 report). The Task 4 report only evaluated the area along the Clinch River from the mouth of White Oak Creek to the confluence of the Clinch and Tennessee Rivers. The Task 4 team's analysis did not, however, include evaluating exposures to the Lower Watts Bar Reservoir. In evaluating current and future exposures for the Lower Watts Bar Reservoir in this public health assessment, ATSDR based its analysis on our 1996 health consultation, which calculated doses by incorporating conservative exposure assumptions using worst-case scenarios. Table 22 in the final PHA presents the committed effective dose to the whole-body of 278 mrem for past radiation exposure associated with the area along the Clinch River, based on data presented in the Task 4 report. Table 23 presents the committed effective dose to the whole-body of less than 236 mrem for current and future exposures to the Clinch River, based on ATSDR's individual evaluation, which is indeed lower than the whole-body dose for past exposure to the Clinch River of 278 mrem. The dose referred to in this comment of "less than 1,900 mrem" refers to the estimated whole-body dose for exposure to the Lower Watts Bar Reservoir, which was based on the findings of ATSDR's 1996 *Lower Watts Bar Reservoir Health Consultation.* Thus, because the Lower Watts Bar Reservoir was not evaluated by the Task 4 team in its evaluation of past exposures to X-10 releases to the Clinch River via White Oak Creek, this dose cannot be compared to the past exposure dose.
Miscellaneous Radiation Comments		
36	Pp. 68 and 70. If the effective rate of decrease of radiation in the body is the sum of the rates of decrease due to radioactive decay and biological elimination, then the reciprocal of the effective half-life should be the sum of the reciprocals of the physical and biological half-lives. The numbers for Sr-90 on p. 68, and in Table 7, don't quite satisfy this relationship, as well as the numbers for Sr-90 on p. 68 not quite agreeing with those in Table 7. The numbers on p. 68 need to agree with those in Table 7, and all the numbers need to satisfy their correct relationship.	Your comment is noted. ATSDR compared the reciprocal of the effective half-life for the radionuclides presented in Table 7 with the sum of the reciprocals of their physical and biological half-lives, and they match. The correct definition of effective half-life is the sum of the radioactive decay constant and the biological decay constant. The decay constant is defined as ln2/half-life, where ln is the natural log. The radioactive decay constant and the biological decay constant have to be in the same units, as they are in Table 7 and in the discussion on pages 71 and 73 of the final PHA.
37	P. 69. Table 7. Compare years rather than days for Strontium 90 to correspond with the discussion on page 68 in which years are used.	ATSDR presented the data in days because the original reference material expressed the biological half-lives in terms of days. Therefore, changes were made in the final PHA to present half-lives in terms of days throughout the discussion on pages 71 and 73 and in the text in Table 7.
38	Please adopt a consistent set of radiation units.	These changes have been made in the final PHA.

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39	Present-day radiation dose limits by national regulatory authorities and national and international advisory committees on radiation protection have been misrepresented. The ATSDR PHA and its accompanying summary document state that the public dose limit of the ICRP, NCRP, and NRC of 100 mrem/y is equivalent to saying that 7000 mrem over a 70-year lifetime is an acceptable cumulative dose. This is not true. These dose limits apply to a single year of exposure from multiple sources of operations (releases). Furthermore, the public dose constraint for releases from a single source is 25 mrem/y. In addition, there is the overarching provision that actual doses to real persons be restricted to levels that are as low as is reasonably achievable. The NCRP negligible dose level is 1 mrem/y. Federal radiation protection standards and ICRP and NCRP recommendations for the limitation of public exposures to ionizing radiation have been improperly cited by ATSDR. These are maximum annual dose limits that apply to the total dose received from multiple sources of exposure. ATSDR misinterprets these annual limits as annual averages that apply over a 70 year lifetime for limitation of public exposures originating from a single operation or source.	No section of this PHA extrapolates the 100 mrem/year dose limit to 7,000 mrem over a 70-year lifetime. Instead, in this PHA ATSDR compares estimated annual doses to the 100 mrem/year dose limit of the International Commission on Radiological Protection (ICRP), the National Council on Radiation Protection and Measurements (NCRP), and the U.S. Nuclear Regulatory Commission (NRC), as well as ATSDR's minimal risk level (MRL). ATSDR compares estimated lifetime doses to the agency's radiogenic cancer comparison value of 5,000 mrem over 70 years, which is based on peer-reviewed literature and other documents developed to review the health effects of ionizing radiation. These values are used as screening tools during the public health assessment process. If the screening indicates that past or current doses exceed our comparison values, then we would conduct further in-depth health evaluation. Even though this was not explicitly stated in the document as implied by the commenter, ATSDR believes that the first approximation of the 100 mrem/year recommended dose limit equates into a 7,000 mrem dose over 70 years (100 mrem/year × 70 years). This lifetime dose is higher than ATSDR's radiogenic cancer comparison value of 5,000 mrem over 70 years. As a matter of note, please recognize that as a first approximation, ATSDR's radiogenic cancer comparison value of 5,000 mrem over 70 years is less than 100 mrem/year (5,000 mrem ÷ 70 years = 71 mrem/year). This value of 71 mrem/year is less than 100 mrem/year as recommended for the public by the ICRP, NCRP, and NRC. ATSDR publicly discussed this issue in at least four Exposure Evaluation Work Group (EEWG) meetings, formerly known as Public Health Assessment Work Group (PHAWG), and three Oak Ridge Reservation Health Effects Subcommittee (ORRHES) meetings. The Ionizing Radiation Toxicological Profile states: "the annual dose of 3.6 mSv [360 mrem] per year has not been associated with adverse health effects or increases in the incidences of any type of cancers in humans or other animals" (ATSDR 1999b). The past annual doses for the Clinch River, as well as the current radiation doses for the Lower Watts Bar Reservoir and the Clinch River, for all pathways combined were below ATSDR's comparison values and below the 100 mrem/year dose limit for the public as recommended by the ICRP, NCRP, and NRC.
40	Delete all wording indicating that exposure to radionuclides originating in White Oak Creek, the Clinch River, or the Lower Watts Bar Reservoir in the past, present, or future have not caused any "harmful health effects" (e.g., as on page 4), "are not expected to cause *any* harmful effects" (e.g., as on page 6), or	The complete wording as presented in the PHA for the sections referenced by the commenter are presented below: Page 4: "ATSDR's evaluation showed that the estimated external and internal radiation doses ***were not expected to cause harmful health effects***. Therefore, ATSDR concluded that past off-site exposure to those radionuclides traveling from X-10 to the Clinch River via

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	"pose *no* threat to public health" (as on page 8) (emphasis added). On the basis of current knowledge, no dose of radiation, including that resulting from exposures to natural background (which includes radon, for which significant health effects have been documented, e.g., even in some residential exposure settings), can be assumed to be completely without risk. All national and international organizations responsible for setting radiation standards and estimating risks posed by radiation exposure recognize that, despite uncertainties in risks at low doses and dose rates, "no alternate dose-response relationship appears to be more plausible than the linear-non-threshold model on the basis of present scientific knowledge" (NCRP 2001). The current wording reflects adversely on the credibility of the ATSDR and the dose levels chosen to represent radiogenic cancer CVs for radiation. Regarding the findings that it was safe to use the shoreline and waterways for recreation, food, and drinking water, he said that's just not right.	White Oak Creek was not a public health hazard." Page 7: "ATSDR's review of environmental data collected in and around the Clinch River and LWBR areas shows that the following practices ■ annual environmental monitoring, ■ institutional controls intended to prevent disruption of sediment, ■ on-site engineering controls to prevent off-site contaminant releases, and ■ DOE continuing its expected appropriate and comprehensive system of monitoring (e.g., of remedial activities and contaminant levels in media), maintenance, and institutional and engineering controls, have limited exposure to the current levels of radionuclides in surface water, sediment, fish, and game to the point that radionuclides ***are not expected to cause any current or future harmful health effects***. Given this evaluation, ATSDR concludes that current and future off-site exposure to radionuclides in the Clinch River and the LWBR via White Oak Creek is not a public health hazard." Page 10: "ATSDR considers that current exposures to detected levels of radionuclides in sediment, surface water, fish, geese, and turtles of the Clinch River ***pose no threat to public health***." Having thoroughly evaluated past public health activities and available current environmental information, ATSDR concludes that exposures to X-10 radionuclides released from White Oak Creek to the Clinch River and to the Lower Watts Bar Reservoir are not a health hazard. Past and current exposures are below levels associated with adverse health effects and regulatory limits. Adults or children who have used, or might continue to use, the waterways for recreation, food, or drinking water are not expected to have adverse health effects due to exposure. ATSDR has categorized those situations as posing *no apparent public health hazard* from exposure to radionuclides related to X-10. This classification means that people could be or were exposed, but that their level of exposure would not likely result in any adverse health effects. For its evaluation of past exposures to X-10 radionuclide releases via White Oak Creek, ATSDR used a dose methodology and considered the 50th percentile estimates provided in Task 4 of the Tennessee Department of Health's Reports of the Oak Ridge Dose Reconstruction (Task 4 report) (available at http://www2.state.tn.us/health/CEDS/OakRidge/WOak1.pdf). The Task 4 team, on the other hand, used a risk model and the upper 95th percentile dose and risk levels. Nonetheless, even using different approaches, we came to the same basic conclusions as described below.

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		On page 15-4 of the Task 4 report, the authors' state: "The radiological doses and excess lifetime cancer risks estimated in this report are incremental increases above those resulting from exposure to natural and other anthropogenic sources of radiation. Nevertheless, for the exposure pathways considered in this task, the doses and risks are not large enough for a commensurate increase in health effects in the population to be detectable, even by the most thorough of epidemiological investigations. In most cases, the estimated organ-specific doses are clearly below the limits of epidemiological detection (1 to 30 cSv [centisievert]) for radiation-induced health outcomes that have been observed following irradiation of large cohorts of individuals exposed either in utero, as children, or as adults." "...it is unlikely that any observed trends in the incidence of disease in populations that utilized the Clinch River and Lower Watts Bar Reservoir after 1944 could be conclusively attributed to exposure to radionuclides released from the X-10 site, even though this present dose reconstruction study has potentially identified increased individual risks resulting from these exposures." Also, the Task 4 report was reviewed by the Oak Ridge Health Agreement Steering Panel (ORHASP)—a panel of experts and local citizens appointed to direct and oversee the Oak Ridge Health Studies. On page 12 of the ORHASP's final report titled *Releases of Contaminants from Oak Ridge Facilities and Risks to Public Health* (available at http://www2.state.tn.us/health/CEDS/OakRidge/ORHASP.pdf), the panel determined, "Although the White Oak Creek releases caused increases in radiation dose, the calculated exposures were small, and less than one excess cancer is expected." In addition, on page 38 of the ORHASP report regarding the number of health effects that would be expected from exposure to X-10 radionuclide releases via White Oak Creek, the panel estimates "less than one excess cancer case from 50 years of contaminated fish consumption" would result. On page 147 of the final public health assessment, "ATSDR concludes that exposures to X-10 radionuclides released from White Oak Creek to the Clinch River and to the Lower Watts Bar Reservoir are not a health hazard. Past and current exposures are below levels associated with adverse health effects and regulatory limits. Adults or children who have used, or might continue to use, the waterways for recreation, food, or drinking water are not expected to have adverse health impacts due to exposure. ATSDR has categorized those situations as posing *no apparent public health hazard* from exposure to radionuclides related to X-10. This classification means that people could be or were exposed, but that their level of exposure would not likely result in adverse health effects." Thus, even though ATSDR used a dose methodology and considered the 50th percentile estimates, while the Task 4 team used a risk model and the upper 95th percentile dose and risk levels, we came to the same basic conclusion. ORHASP found that less than one

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		excess cancer case would be expected to occur as a result of exposure to X-10 radionuclide releases via White Oak Creek; ATSDR concluded that this exposure was not expected to cause adverse health effects.
Quantitative Risk Assessment and Uncertainty/Sensitivity Analyses		
41	The failure of ATSDR to acknowledge the presence and magnitude of individual risk from radiation is inconsistent with ATSDR practice for other known human carcinogens. This long-standing concern has been raised before the ORRHES and the ATSDR by many members of the Oak Ridge community and others. ATSDR has remained persistently non-responsive in this matter. I believe that it would be appropriate for the range of risks associated with doses below the ATSDR cancer comparison values to be discussed and acknowledged. The ATSDR draft PHA concludes that there is no health hazard from exposure to past, present, or future releases, but does not discuss or disclose the levels of individual risks of radiogenic cancer incidence that are associated with these exposures. The impression that there is no concern at doses below the specified cancer Comparison Values (CVs) for radiation exposure is misleading. A distinction needs to be made between levels of exposure likely to produce statistically significant relative risks in an epidemiological study and levels of exposure that constitute significant relative and excess lifetime risks to individuals. Discussion of individual risks of cancer is notably lacking in the PHA, even though the quantification of excess risk, with uncertainty, was the main focus of the Oak Ridge Dose Reconstruction Task 4 Report. In the Oak Ridge Dose Reconstruction Task 4 Report, the upper limits of the 95% credibility interval of the excess lifetime risk range from 1.6 to 4 chances in ten thousand at Kingston, and from 5.4 chances in ten thousand to 3.8 chances in one thousand at Jones Island on the Clinch River (see Table 13.D.1 of Apostoaei et al, 1999). The lower credibility limits approach or exceed a risk of one in one hundred thousand at all locations.	ATSDR recognizes that every radiation dose, action, or activity may have an associated risk. The fact that we did not previously present details on individual risk for radiation in the public health assessment is not inconsistent with ATSDR practice, as suggested by the commenter, because to develop conclusions we use a dose methodology in our assessments. In the public health assessment process, techniques similar to those of the quantitative risk assessment methods (i.e., generating quantitative "risk estimates"), such as those used in the Task 4 of the Tennessee Department of Health's Reports of the Oak Ridge Dose Reconstruction (Task 4 report), may be used primarily as a screening tool to rule out clearly the existence of public health hazards or as a way of understanding regulatory concerns. If, however, exposure at a site exceeds one or more media-specific comparison values (dose-based comparison values or quantitative risk estimates), the public health assessment process proceeds with a more in-depth health effects evaluation. ATSDR scientists conduct a health effects evaluation by carefully examining site-specific exposure conditions about actual or likely exposures; conducting a critical review of available toxicological, medical, and epidemiologic information to ascertain the substance-specific toxicity characteristics (levels of significant human exposure); and comparing an estimate of the amount of chemical exposure (i.e., dose) to which people might frequently encounter at a site to situations that have been associated with disease and injury. This health effects evaluation involves a balanced review and integration of site-related environmental data, site-specific exposure factors, and toxicological, radiological, epidemiologic, medical, and health outcome data to help determine whether exposure to contaminant levels might result in harmful effects. The goal of the health effects evaluation is to decide whether harmful effects might be possible in the exposed population by weighing the scientific evidence and by keeping site-specific doses in perspective. The output is a qualitative description of whether site exposure doses are of sufficient nature and magnitude to trigger a public health action to limit, eliminate, or study further any potential harmful exposures. The PHA report presents conclusions about the actual existence and level of the health threat (if any) posed by a site. It also recommends ways to stop or reduce exposures. The conclusions and recommendations are based on the professional knowledge and judgment of the health assessment team members. Because, however, of uncertainties regarding exposure conditions and because of adverse effects associated with

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		environmental levels of exposures, definitive answers on whether health effects actually will or will not occur are not possible. That said, providing a framework that puts site-specific exposures and the potential for harm in perspective is possible and is one of the primary goals of the public health assessment process. For this PHA, ATSDR added an appendix (Appendix F) to discuss risk terminology, radiation risk, and risk limits in detail. The appendix also explains the differences between ATSDR public health assessments and EPA risk assessments and shows the method for converting the doses in this PHA to risk numbers. Please note that although ATSDR does not base its public health conclusions on these risk numbers, they are presented in this PHA to provide for the community detailed information on risk.
42	The excess lifetime risk levels associated with ATSDR's cancer CVs for radiation are much higher than the risk levels ATSDR uses in its evaluation of other human carcinogens. For exposures to other human carcinogens, ATSDR usually considers risks in the range of one chance in ten thousand to one chance in one million to warrant more detailed investigation. For non-cancer producing toxic substances, ATSDR typically applies a series of safety factors to the lowest observed adverse effects level to derive an exposure level that can be considered to have a minimum risk. For exposure to radiation, the majority of scientific opinion is that there is no threshold dose below which the risk from exposure can be considered to be zero.	The risk range cited is the typical risk range used by the U.S. Environmental Protection Agency (EPA) in its evaluations of contaminants in the environment. Many of these evaluations may not necessarily be based on health, but entirely on risk assessments. The ATSDR Cancer Policy Framework, adopted in 1993, addresses many factors that must be evaluated in analyzing environmental exposures. ATSDR recognizes that at present no single generally applicable procedure for exposure assessment is available, and therefore exposures to carcinogens are best assessed on a case-by-case basis, with an emphasis on exposure prevention. There are subtle differences in ATSDR's process of evaluating chemicals and radiation such as dose to individual organs, age-specific dose coefficients, and other metabolic differences as discussed in several ICRP publications. In its 1989 Report 96 (titled: *Comparative Carcinogenicity of Ionizing Radiation and Chemicals*), the National Council on Radiation Protection and Measurements (NCRP) stated that less than 30 chemicals were known to be cancer-inducing in humans and of those, in most it was not possible to define a dose-incidence relationship except generally. Also, there is much more uncertainty in chemical metabolism, the possibility of additive or synergistic effects between or among chemicals, potency, and dosimetry than in radiation evaluations. The NCRP stated that risk assessment for chemicals is "generally more uncertain than risk assessments for radiation." Because of these statements by the NCRP, ATSDR does not, in the true sense of the comment, evaluate radiation in the similar manner as it evaluates chemicals. In this public health assessment, ATSDR compares annual doses to the 100 mrem/year dose limit of the International Commission on Radiological Protection (ICRP), the NCRP, and the U.S. Nuclear Regulatory Commission (NRC), as well as ATSDR's minimal risk level (MRL). ATSDR compares lifetime doses to the agency's radiogenic cancer comparison value of 5,000 mrem over 70 years, which is based on peer-reviewed literature and other documents developed to review the health effects of ionizing radiation. These values, used

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		as screening tools during the public health assessment process, are levels below which adverse health effects are not expected to occur. If the screening indicates that past or current doses exceed our comparison values, then we would conduct further in-depth health evaluation. ATSDR incorporated safety margins when it developed its screening values for radiation exposures. The approach ATSDR uses to derive MRLs, such as those in the Toxicological Profile for Ionizing Radiation, was developed with the EPA. The screening value includes the use of a no observed adverse effect level (NOAEL) or a lowest observed adverse effect level (LOAEL) as well as three or more situation-specific uncertainty factors; when multiplied, these factors give a total uncertainty factor generally ranging from 1 to 1,000 based on the studies used. Furthermore, the ATSDR legislative authority, as discussed many times, limits ATSDR to evaluate exposures based on observable and tolerable adverse health effects. If adverse health effects are not observed in an epidemiological study, then the doses used in the study should be considered tolerable. ATSDR's radiogenic comparison value of 5,000 millirem over 70 years incorporates the linear no-threshold (LNT) model for evaluating public health hazards associated with exposure to radiation. It assumes a total lifetime dose (70 years of exposure) above background that is considered safe in terms of cancer induction. In addition to the LNT model, ATSDR also incorporates a margin-of-dose (MOD) approach into this comparison value. During an evaluation, if ATSDR determines that further investigation is needed, scientific literature associated with radiological doses and dose estimates, particularly those related to adverse health effects, is reviewed. Then, ATSDR compares the dose estimates from scientific literature to site-specific dose estimates. Thus, ATSDR uses the LNT model to determine when a more detailed site-specific evaluation is necessary, and uses the MOD approach to develop realistic information for communities regarding what is known and unknown about radiation levels at a particular site. An independent expert panel convened to review ATSDR's site-specific approaches used to evaluate past, current, and future radiation risks to communities surrounding the Oak Ridge Reservation concluded that this combination of approaches (LNT and MOD) is appropriate for ATSDR to use to determine radiation levels at which health effects actually occur. The panel found that ATSDR's use of the MRL of 100 millirem and radiogenic cancer comparison value of 5,000 millirem were appropriate screening values. If extrapolated over 70 years assuming constant exposure, the radiogenic cancer comparison value dose estimate would be about 71 millirem per year—a level the panel determined to be protective of public health in terms of cancer and noncancer risks. The panel also concluded that ATSDR's approach considers evidence for both individual organs and whole-body doses (effective doses), noting that a whole-body dose could not be developed without accounting

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		for doses to single organs. Further, the panel determined that ATSDR's method of distinguishing dose levels from risk levels was acceptable because ATSDR incorporated risk and LNT explicitly and implicitly when calculating doses. In the words of one peer reviewer regarding ATSDR's radiogenic cancer comparison value, "The general consensus is that the linear non-threshold hypothesis is scientifically reasonable for the purpose of radiation protection. The recent NCRP comprehensive review and UNSCEAR [United Nations Scientific Committee on the Effects of Atomic Radiation] evaluations do not find any alternative model to be better, including one with a threshold. While epidemiology is not capable of detecting risks in the low dose domain, under say 10,000–20,000 millirem, there are cellular experiments and theoretical reasoning that support a linear response."
43	Needless to say, the ATSDR could have avoided considerable negative criticism among scientists knowledgeable in the estimation of radiogenic cancer risk if the Agency had produced a quantitative estimate of cancer risk, instead of relying on crude estimates of epidemiological limits of detection in human epidemiological studies and making a policy decision that epidemiological limits of detection for radiogenic cancers in human cohorts are appropriate as surrogates for a limit of public health concern.	The independent external peer reviewers were satisfied with the results expressed in dose in this public health assessment (see Appendix H for the peer reviewer comments and ATSDR's responses). This comment is interesting, considering that risk estimates are based on the "crude estimates of epidemiological limits of detection." ATSDR's policy decision was reviewed by an external independent peer review panel comprised of radiation scientists and epidemiologists (see the response to comment 42 for more information on the findings of the peer review panel). The agency also solicited comments from reviewers at the National Cancer Institute and the International Epidemiology Institute. The peer reviewers were satisfied with ATSDR's approach. In the words of one peer reviewer, a highly respected radiation epidemiologist, "The general consensus is that the linear non-threshold hypothesis is scientifically reasonable for the purpose of radiation protection. The recent NCRP [National Council on Radiation Protection and Measurements] comprehensive review and UNSCEAR [United Nations Scientific Committee on the Effects of Atomic Radiation] evaluations do not find any alternative model to be better, including one with a threshold. While epidemiology is not capable of detecting risks in the low dose domain, under say 10,000–20,000 mrem, there are cellular experiments and theoretical reasoning that support a linear response." In response to a dose versus risk issue, this expert also stated that "Radiation protection is based on limiting dose to the public and to workers. Thus international and national committees make recommendations and national policy and regulatory bodies make judgments as to the allowable doses for the population. Dose limits are roughly based on risk of adverse health effects, and in the case of exposure to ionizing radiation it is primarily the cancer risk at low doses that is of concern. Heritable effects (genetic effects in future generations) have not been demonstrated in humans and are now believed to be much

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		lower than originally suspected based on experimental studies." Further, the issue with applying a "quantitative" risk coefficient to any dose is that one can calculate any risk and this is "perceived" as a true value. As stated in the ATSDR Cancer Framework Policy, "This artificial appearance of precision can lead decision makers to rely heavily on numerical risk estimates. Although ATSDR recognizes the utility of numerical risk estimates in risk analysis, the Agency considers these estimates in the context of the variables and assumptions involved in their derivation and in the broader context of biomedical opinion, host factors, and actual exposure conditions." For additional information, please review the framework policy that can be found at http://www.atsdr.cdc.gov/cancer.html. For this PHA, ATSDR nonetheless added an appendix (Appendix F) to discuss risk terminology, radiation risk, and risk limits in detail. The appendix also explains the differences between ATSDR public health assessments and EPA risk assessments and shows the method for converting the doses in this PHA to risk numbers. Please note that ATSDR does not base its public health conclusions on these risk numbers; they are presented here to provide the community with detailed information on risk.
44	Page 6, Line 2: ATSDR needs to remain instep with the EPA in the methodology for performing risk assessments for DOE sites. It is EPA and CERCLA (Comprehensive Environmental Response Compensation and Liability Act) and not ATSDR that has the regulatory authority to stipulate the proper methodology to be used to perform radiological risk assessments. ATSDR needs to follow EPA's lead of using CERCLA slope factors for radionuclides, and not the 'millirem approach' in its estimation of risks from the ingestion of radioactively contaminated fish. In case ATSDR is uniformed about how to do this please refer to an EPA publication that documents the proper selection of risk assessment tools to be used in the evaluation of a radioactively contaminated stream. EPA 904-R-97-010. Title: Compendium of Issues surrounding the levels of contaminants contained in fish collected in tributaries leaving the Savannah River Site (SRS) and associated risk from exposure to those levels of contaminants. It was this risk assessment that documented a hazard with radioactive contamination of fish in the Savannah River (located between Georgia and South Carolina and downstream from another DOE facility, the Savannah River Site in Akin, SC. The characterization of these environmental	ATSDR and EPA have distinct purposes and goals that necessitate different types of assessments, as explained in ATSDR"s Public Health Assessment Guidance Manual (http://www.atsdr.cdc.gov/HAC/PHAManual/toc.html), EPA's *Risk Assessment Guidance for Superfund – Human Health Evaluation Manual*, and in *A Citizen's Guide to Risk Assessments and Public Health Assessments at Contaminated Sites* (written jointly by ATSDR and EPA Region IV; see http://www.atsdr.cdc.gov/publications/CitizensGuidetoRiskAssessments.html). An ATSDR health assessment is a mechanism to provide the community with information on the public health implications of a specific site, identifying populations for which further health actions or studies are needed. The health assessment might also make recommendations for actions necessary to protect public health. An EPA baseline risk assessment is used to support the selection of a remedial measure at a site. An overview of the public health assessment process ATSDR uses to evaluate whether people will be harmed by hazardous materials is available at: http://www.atsdr.cdc.gov/training/public-health-assessment-overview/html/index.html. A comprehensive guide to the Superfund risk assessment process is available from EPA on the Internet at: http://www.epa.gov/superfund/health/risk/index.htm. To understand why in the public health assessment process ATSDR scientists use doses (instead of the quantitative baseline risk assessments conducted by regulatory agencies,

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	releases of hazardous chemical (both radioactive and non-radioactive) from SRS directly resulted in a Fish Advisory being issued to advise the public of associated health risks. This joint effort of EPA, DOE, Georgia, and South Carolina added significant value to these agencies' joint efforts to protect the public health. ATSDR should use this laudatory state and federal collaboration as a case study in how to proceed in a constructive fashion in their work with stakeholders downwind and downstream of the DOE ORR. Page 93, Table 15. Estimated Whole Body Radiation Does For Current Lower Watts Bar Reservoir Exposure Pathways. Refer to the comment concerning need to use 'slope factors,' and not 'millirems' in performing CERCLA risk analyses for ingested radionuclides. Page 100, Table 20. Estimated Radiation Doses From Current Consumption of Fish. Refer to comment for Page 90, Table 13. This PHA is becoming increasingly complicated because of ATSDR's intransigence in not utilizing the standard methodology specified in EPA CERCLA RAGs for risk analyses of ingested radionuclides. ATSDR needs to better inform itself by consulting with available guidance on EPA's Superfund Web sites to obtain information on how to perform a risk analysis that can meet the muster of CERCLA. After all ATSDR is supposed to already know this and should not have to be informed of this from stakeholders. Better, ATSDR should immediately consult with its sister federal agency, specifically the EPA Southeastern Regional Office of EPA in Atlanta, GA as to how was it that the EPA was able to facilitate an interstate fish advisory for the Savannah River because of offsite radioactive releases from the Savannah River site (SRS), near Akin, SC. Also, consult the EPA's OLS (Online Library System) at the following website: www.epa.gove/natlibra/ols.htm and use the search terms Savannah River Fish. This search will give you the details of a risk assessment for radioactively contaminated fish. ATSDR should use a comparable approach, one consistent with current EPA CERCLA RAGs, to produce a more valid PSA for communities downstream from DOE ORR. Here is the OLS citation and call number for EPA 904/R-96/006 as it appears online: Main Title Potential human health effects of ingesting fish which are taken from locations near the Savannah River site (SRS). Publisher US Environmental Protection Agency, Region 4. Year Published	such as EPA) it is important to understand the intentional differences between ATSDR's health assessments and EPA's risk assessments. The public health assessment is different from a risk assessment in its purpose, its goals, the exposures evaluated, and the use of information. The table below outlines the primary differences between an ATSDR public health assessment and an EPA baseline risk assessment. **ATSDR Public Health Assessment vs. EPA Baseline Risk Assessment** **Agency** / **ATSDR** / **EPA** **Type of Assessment** / **Public Health Assessment** / **Baseline Risk Assessment** **Description** / The public health assessment process is an evaluation of data and information (environmental data, health outcome data, and community concerns) pertaining to the release of hazardous substances into the environment. Its purpose is to assess the likelihood of health effects from exposure to hazardous substances and to identify appropriate public health actions to evaluate or prevent health effects. In addition, ATSDR uses the process to respond to site-specific community health concerns. It is qualitative, site-specific, and focuses on medical and public health perspectives. / The quantitative baseline risk assessment, the framework of the EPA human health evaluation, is a numerical analysis of environmental data used to characterize the probability (theoretical risk) of adverse effects as defined by regulatory standards and the requirement for the remedial investigation/ feasibility study (RI/FS) at Superfund sites. It is a quantitative, chemical-oriented characterization that uses statistical models to estimate risk from a regulatory perspective. **Purpose** / To provide community members and environmental / To assist risk management decision-making in the

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	1996. OCLC Number 36482354. Report Number EPA 904/R-96/006. Holdings LIBRARY CALL NUMBER EKAM. RA602.F5P6. Owner Libraries EKA – Region 4 Library/Atlanta, GA. Holding Modified LIBRARY Date Modified EKA 19970314. Place Published Atlanta, GA. Bib Levl m. OCL Time Stamp 19970304154240. Cataloging SOURCE OCLC/T. Language ENG. PUB Date Free Form May 1996. Collation var. paging chiefly table 28 cm. Notes "EPA 904/R-96/006" "May 1996." Subject Added Net Health risk assessment-Savannah River Region (Ga. And S.C.); Fish as food-Contamination-Savannah River Region (Ga. And S.C.); Water quality – Savannah River Region (Ga. And S.C.). CORP Au Added Net United States. Environmental Protection Agency. Region IV ; United States. Department of Energy; United States. Environmental Protection Agency. Region IV; United States. Department of Energy. OCLC Rec Leader 00953nam 2200241Ka 45010. Stakeholders know this volume is an easy to read guide on how to perform their own risk analysis of radioactively contaminated fish. This guide should prove useful in performing a comparable risk analysis of fish downstream from DOE ORR, from Clinch River Mile 1 (CRM1) to at least to the TVA Mocassin Bend embayment. The radionuclide fish tissue is reality extractable from the OREIS database and can be easily analyzed according to the method in the EPA report. This guide could also be used to map 'hot spot' fishing holds throughout the TVA dendritic system fro Oak Ridge, TN to Paducah, KY. The TVA has an online, interactive, map of the TVA tributaries for all seven states of the system, and the necrotic locations are easily identified. Also, TVA's three nuclear pants are pinpointed as well: Browns Ferry, Sequoia, and Watts Bar. The Web site for this very useful map of the area(s) potentially impact by these radioactively contaminated fish is available online at: www.tva.gov/sites/sites ie2.htm. Page 102, Table 21. Summary of Public Health Implications From ATSDR's Evaluation of Past and Current Exposure to Radionuclides Released to the Clinch River/Lower Watts Bar Reservoir. The 'millirem' approach that ATSDR is persisting to utilize here is not in sync with current EPA RAGs guidance for doing risk analyses. Redo all of these analyses using current EPA RAGs guidance. Potentially exposed stakeholders will	

	and public health agencies with conclusions about the actual existence or level of the public health hazard posed by exposure to hazardous substances at a specific site and to identify populations for which further public health actions or studies are needed to evaluate or prevent health effects.	selection of remedial actions involving hazardous site cleanup strategies (the determination of permit levels for the discharge, storage, or transport of hazardous waste; the establishment of clean-up levels; the determination of allowable levels of contamination).
Goal	To determine whether harmful health effects are expected from contaminants in the environment and to make recommendations for actions needed to protect public health, which may include issuing health advisories.	To provide a framework for developing the risk information necessary to assist decision-making at remedial sites.
Objectives	•To determine the nature and extent of contamination •To define potential human exposure pathways •To identify populations who may be or may have been exposed •To determine the health implications and public health hazards of site-related exposures, using environmental, toxicological, medical, and health outcome data	•To help determine whether additional remedial response action is necessary at a site •To provide a basis for determining residual chemical levels that are adequately protective of health •To provide a basis for comparing potential health impacts of various remedial alternatives •To help support selection

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	definitely be doing their own risk analyses of these exposures. These risk analyses will be using the now standard EPA approach cited above that uses, for example, pCi/gm of radionuclides in fish. These stakeholders will not be using the millirem' approach that ATSDR persists in using because it is too easy to discount each incremental cumulative radiation exposure one at a time as being inconsequential. ATSDR should be doing so too so that it can catch up with the stakeholders' own assessments. In addition to the OREIS fish data, ASER also has robust fish data in its data volume which can be accessed at http://www.ornl.gov/sci/env_rpt/. To get to the data volume you need to scroll down to the index and the data bookmark is typically near the bottom for each year. All fish data are given in picocuries per gram. (1 pCi = 3.75E-02 Bequerels [Bq]). This is another good reason that ATSDR must move to using the standard EPA 'slope factor' approach, which measures exposure dose in pCi – not millirems (mrem). If ATSDR persists in using the dated mrem approach in performing its exposure assessment it will be out of sync with both standard EPA practice and those stakeholders doing their own 'alternative' risk analyses. Also, the OREIS biota/fish data date all the way back to 1985. A plethora of fish data for stakeholders interested in detailed data – or in doing risk calculation and statistics on their own ATSDR should reasonably anticipate that there will be plenty of 'alternative' stakeholder-developed risk analyses of WOC releases. How will ATSDR contend with these foreseeable developments if it is not using the same methodology that stakeholders will be using? Page 108, Line 17. ATSDR is utilizing methodology, which is not consistent to the legal requirements of CERCLA. ATSDR must use standard EPA Risk Assessment Guidelines (RAGs) for ingested radionuclides. These ingested radionuclides are to be treated the same as all other chemical carcinogens. These ingested radionuclides are not to be cranked into the dated approach of simply comparing 'millirems' of exposure to a hypothetical annual dose for an 'average' citizen. ATSDR is ostensibly a 'client' federal agency for EPA, and EPA is one of its 'customer' federal agencies – also partnering with DOE and DOD. All three federal agencies contribute millions of dollars to fund ATSDR through interagency transfer of tax dollars. Why is ATSDR so			
			•To address those public health implications by recommending relevant public health actions to prevent harmful exposures •To identify and respond to community health concerns	of the "no-action" remedial alternative •To identify remedial actions that pose an acceptable risk as defined by regulatory standards
		Exposures and Pathways Evaluated	To evaluate site-specific exposure conditions about actual or likely past, current, and future exposures.	To evaluate possible current or future exposures and consider all contaminated media regardless of whether exposures are occurring or likely to occur.
		Result	The public health assessment provides ATSDR's conclusion regarding the degree of public health hazard, if any, posed by a site or hazardous substances in the environment and recommends appropriate public health actions needed to limit, eliminate, or further study any potential harmful exposures. The report provides a qualitative description of whether exposures to hazardous substances are of sufficient nature and magnitude to be a public health hazard and trigger	The EPA baseline risk assessment provides a quantitative estimate of theoretical risk used to support the selection of a remedial measure at a site. These quantitative estimates of risk are based on default exposure and toxicity assumptions that represent a prudent conservative (protective) approach: that of prevention. These conservative assumptions ensure that remedial actions are amply safe and protective of health. The risk estimates are not

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	unresponsive to using standard EPA Risk Assessment Guidelines (RAGs) for ingested radionuclides? The citizens of Oak Ridge and the citizens of all downwind and downstream potentially impacted communities will do their own research to come up with valid risk analyses if they have to, and ATSDR should realize that we are fully capable of protecting our own public health. (*Comments received on the initial release PHA dated December 2003.)* No mention is made of the EPA regulatory standards for public exposure to radiation, which includes the Safe Drinking Water Act of 4 mrem per year, or the fact that EPA generally regards cumulative individual risks to maximally exposed individuals on the order of one chance in ten thousand (approximately equal to about 100 mrem cumulative whole body dose over a 30 year exposure period) to merit consideration for remedial action. For carcinogenic chemicals, excess lifetime risks to maximally exposed individuals from between one chance in ten thousand and one chance in one million may be considered for remedial action at contaminated sites, but usually some form of action is taken when these risks exceed one chance in ten thousand.		public health actions. Because of uncertainties, a definitive answer on whether health effects actually will or will not occur is not possible. However, the report puts exposures and the potential for harm in perspective.	intended to predict the incidence of disease or measure the actual health effects in people as a result of a site.
		Methods	The public health assessment process is iterative and dynamic. In the initial screening evaluation, similar techniques to those of the quantitative risk assessment methods may be used primarily as a screening tool to clearly rule out the existence of public health hazards. If, however, during this screening assessment the estimated dose exceeds one or more media-specific comparison values (dose-base comparison values or quantitative risk estimates), the public health assessment process proceeds with a more in-depth health effects evaluation. ATSDR scientists conduct a health effects evaluation by carefully examining site-specific exposure conditions and comparing an estimate	The quantitative theoretical risk estimates are based on statistical and biological models that include a number of protective assumptions about exposure and toxicity to ensure protection of the public. By design, they are conservative estimates that generally overestimate health risk. Therefore, people will not necessarily be affected even if they are exposed to materials at dose levels higher than those estimated by the risk assessment. For cancer effects, risks are expressed as probabilities. These probability risks are not intended to predict the incidence of disease or measure the actual health effects a site has on people. For noncancer effects, exposure levels are

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		<table><tr><td></td><td>of the amount of chemical exposure (i.e., dose) that people might frequently encounter at a site to situations that have been associated with disease and injury. This health effects evaluation involves a balanced review and integration of site-related environmental data, site-specific exposure factors, and toxicologic, epidemiologic, radiologic, and medical information to help determine whether exposure to contaminant levels might result in harmful effects. The goal of the health effects evaluation is to decide whether or not harmful effects might be possible in the exposed population by weighing the scientific evidence and by keeping site-specific doses in perspective.</td><td>compared to pre-established levels deemed to be safe.</td></tr></table> **Public Health Assessment** The public health assessment process serves as a triage for evaluating the public health implications of exposure to environmental contamination and for identifying appropriate public health actions for particular communities. PHAs are used to identify off-site populations 1) who are exposed to hazardous substances; 2) to determine how and when they were exposed; 3) to determine whether these past, present, or future exposures are likely to lead to illness; and 4) to recommend follow-up public health actions to address the exposure and ensure the protection of public health. The public health assessment process, which may lead to a variety of public health actions, serves as a mechanism through which

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		the agency responds to site-specific community health concerns. In the public health assessment process, similar techniques to those of the quantitative risk assessment methods (i.e., generating quantitative "risk estimates") may be used primarily as a screening tool to clearly rule out the existence of public health hazards or as a way of understanding regulatory concerns. If, however, exposure at a site exceeds one or more media-specific comparison values (dose-based comparison values or quantitative risk estimates), the public health assessment process proceeds with a more in-depth health effects evaluation. ATSDR scientists conduct a health effects evaluation by carefully examining site-specific exposure conditions about actual or likely exposures; conducting a critical review of available toxicological, medical, and epidemiologic information to ascertain the substance-specific toxicity characteristics (levels of significant human exposure); and by comparing an estimate of the amount of chemical exposure (i.e., dose) to which people might frequently encounter at a site to situations that have been associated with disease and injury. This health effects evaluation involves a balanced review and integration of site-related environmental data, site-specific exposure factors, and toxicological, radiological, epidemiologic, medical, and health outcome data to help determine whether exposure to contaminant levels might result in harmful effects. The goal of the health effects evaluation is to decide whether harmful effects might be possible in the exposed population by weighing the scientific evidence and by keeping site-specific doses in perspective. The output is a qualitative description of whether site exposure doses are of sufficient nature and magnitude to trigger a public health action to limit, eliminate, or further study any potential harmful exposures. The PHA presents conclusions about the actual existence and level of the health threat (if any) posed by a site. It also recommends ways to stop or reduce exposures. The conclusions and recommendations are based on the professional knowledge and judgment of the health assessment team members. Because, however, of uncertainties regarding exposure conditions and adverse effects associated with environmental levels of exposure, definitive answers on whether health effects actually will or will not occur are not possible. But providing a framework that puts site-specific exposures and the potential for harm in perspective is possible. In fact, it is one of the primary goals of the public health assessment process. **Baseline Risk Assessment** The quantitative baseline risk assessment (the framework of the EPA human health evaluation) is a numerical analysis used to determine whether levels of chemicals at hazardous waste sites pose an unacceptable risk as defined by regulatory standards and requirements. The risk assessment process is used by regulators as part of site remedial investigations to support risk management decisions and to define remedial actions

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		involving hazardous site cleanup strategies (the determination of permit levels for the discharge, storage, or transport of hazardous waste; the establishment of clean-up levels; and the determination of allowable levels of contamination) that ensure overall protection of human health and the environment. Remedial plans based on a quantitative risk assessment represent a prudent public health approach—that of prevention. The EPA risk assessment provides an estimate of theoretical risk from possible current or future exposures and considers all contaminated media regardless of whether exposures are occurring or are likely to occur. For cancer effects, risks are expressed as probabilities. For noncancer effects, exposure levels are compared to pre-established levels deemed to be safe. The quantitative risk estimates are not, however, intended, to predict the incidence of disease or measure the actual health effects in people resulting from hazardous substances at a site. The estimated predictions are based on statistical and biological models that include a number of protective assumptions about exposure and toxicity to ensure protection of the public. By design, they are conservative predictions that generally overestimate risk. For this reason, risk estimates are very useful in deciding the extent to which a site needs to be cleaned up (and to what levels) to protect public health adequately. Risk assessment involves estimating exposure doses based on conservative (protective) standard (or default) exposure and toxicity assumptions (which often overestimate health risk) to ensure that remedial actions are amply safe and protective of health. Therefore, people will not necessarily be affected even if they are exposed to materials at dose levels higher than those estimated by the risk assessment. EPA's quantitative risk assessments, which are used for regulatory purposes, do not provide perspective on what the risk estimates mean in the context of the site community and do not measure the actual health effects that hazardous substances have on people. **Conclusions** For its evaluation of past exposures to X-10 radionuclide releases via White Oak Creek, ATSDR used a dose methodology and considered the 50th percentile estimates provided in Task 4 of the Tennessee Department of Health's Reports of the Oak Ridge Dose Reconstruction (available at http://www2.state.tn.us/health/CEDS/OakRidge/WOak1.pdf). The Task 4 team, on the other hand, used a risk model and the upper 95th percentile dose and risk levels. Nonetheless, even using different approaches, we came to the same basic conclusions as described below. According to page 15-4 of the Task 4 report, "The radiological doses and excess lifetime cancer risks estimated in this report are incremental increases above those resulting from exposure to natural and other anthropogenic sources of radiation. Nevertheless, for the exposure pathways considered in this task, the doses and risks are not large enough for a

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		commensurate increase in health effects in the population to be detectable, even by the most thorough of epidemiological investigations. In most cases, the estimated organ-specific doses are clearly below the limits of epidemiological detection (1 to 30 cSv [centisieverts]) for radiation-induced health outcomes that have been observed following irradiation of large cohorts of individuals exposed either in utero, as children, or as adults." "…it is unlikely that any observed trends in the incidence of disease in populations that utilized the Clinch River and Lower Watts Bar Reservoir after 1944 could be conclusively attributed to exposure to radionuclides released from the X-10 site, even though this present dose reconstruction study has potentially identified increased individual risks resulting from these exposures." Also, the Task 4 report was reviewed by the Oak Ridge Health Agreement Steering Panel (ORHASP)—a panel of experts and local citizens appointed to direct and oversee the Oak Ridge Health Studies. On page 12 of the ORHASP's final report titled *Releases of Contaminants from Oak Ridge Facilities and Risks to Public Health* (available at http://www2.state.tn.us/health/CEDS/OakRidge/ORHASP.pdf), the panel determined that "Although the White Oak Creek releases caused increases in radiation dose, the calculated exposures were small, and less than one excess cancer is expected." On page 147 of the final public health assessment, "ATSDR concludes that exposures to X-10 radionuclides released from White Oak Creek to the Clinch River and to the Lower Watts Bar Reservoir are not a health hazard. Past and current exposures are below levels associated with adverse health effects and regulatory limits. Adults or children who have used, or might continue to use, the waterways for recreation, food, or drinking water are not expected to have adverse health impacts due to exposure. ATSDR has categorized those situations as posing *no apparent public health hazard* from exposure to radionuclides related to X-10. This classification means that people could be or were exposed, but that their level of exposure would not likely result in adverse health effects." Thus, even though ATSDR used a dose methodology and considered the 50th percentile estimates, while the Task 4 team used a risk model and the upper 95th percentile dose and risk levels, we came to the same basic conclusion. ORHASP found that less than one excess cancer case would be expected to occur as a result of exposure to X-10 radionuclide releases via White Oak Creek; ATSDR concluded that this exposure posed *no apparent public health hazard*. That said, for this PHA ATSDR added an appendix (Appendix F) to discuss risk terminology, radiation risk, and risk limits in detail. The appendix also explains the differences between ATSDR public health assessments and EPA risk assessments and shows the method for converting the doses in this PHA to risk numbers. Please note that

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		ATSDR does not base its public health conclusions on these risk numbers; they are presented in this PHA only to provide detailed information on risk for the community.
45	Page 106, Line 5. This is ridiculous. ATSDR, an advisory federal agency, is supposed to work hand-in-glove with EPA, a regulatory federal agency, to protect the public health of stakeholders downwind, downstream, and down-aquifer form DOE ORR. Yet ATSDR persists in not using standard EPA risk assessment guidance in developing its WOC 'Public Health Assessment.'	Please see the response to comment 44 regarding ATSDR's policy on performing risk assessments. Also, for this PHA, ATSDR added an appendix (Appendix F) to discuss risk terminology, radiation risk, and risk limits in detail. The appendix also explains the differences between ATSDR public health assessments and EPA risk assessments and shows the method for converting the doses in this PHA to risk numbers. Please note that ATSDR does not base its public health conclusions on these risk numbers; they are presented in this PHA only to provide detailed information on risk for the community.
	ATSDR states flatly: "Currently, there are not federal regulations pertaining to the ingestion of radiological contaminated food." This is a very ignorant statement, which is not factual. ATSDR needs to use the following reference, which includes guidance of the risk analysis of radioactive contaminants for all possible routes of exposure, including fish: Main Title Risk Assessment Guidance for Superfund. Volume 1. Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals [PRGs]). Corp Author Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response. Publisher Dec 91 Year Published 1991 Report Number OSWER-9285.7-01B; Stock Number PB92-963333 Subjects Hazardous materials; Public health; Pollution Control; Toxicity; Exposure; Investigations; Objectives; Selection; Decision making; Superfund; Remedial response Holding. Chapter 4 of this volume, RISK-BASED PRGs FOR RADIOACTIVE CONTAMINANTS, is the one that ATSDR need to acquit itself with because this is the reference that EPA and other stakeholders in the community are using. ATSDR, and stakeholders as well, can access this reference online at the following website: www.epa.gov/superfund/programs/risk/ragsb/chapt4.pdf.	The referenced statement, "Currently, there are no federal regulations pertaining to the ingestion of radiological contaminated food," was removed during subsequent revisions and is not included in the final PHA. It is nonetheless important to note that this is not, as this comment states, a "very ignorant statement, which is not factual." Guidance documents refer to ingestion of radiologically contaminated food, but these are not the same as federal regulations. In contrast to federal regulations, guidance documents, while they may offer suggested guidelines, are not legally enforceable.
	ATSDR needs to desist from its fallacious assertions of 'No Risk' when it is not even using standard EPA risk analysis guidelines. Consequently, this entire WOC PHA is fatally flawed and should be immediately redrafted using the standard EPA guidance cited above. (*Comment received on the initial release PHA dated December 2003.)*	ATSDR is not sure what is referenced in the comment that "ATSDR needs to desist from its fallacious assertions of 'No Risk.'" As mentioned in the response to comment 44, ATSDR does not perform risk assessments; we conduct public health assessments. Further, neither previous versions of this PHA nor the final version mention "no risk." . As explained previously (see response to comment 27), ATSDR bases its conclusions on estimated doses compared to health guidelines (e.g., MRL) where observable health effects have been observed—not on theoretical risk for possible exposures whether they are occurring or are likely to occur. Therefore, ATSDR would not make a "no risk" conclusion. Instead, in this final PHA, ATSDR concludes that "Exposures to X-10 radionuclides released from White

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		Oak Creek to the Clinch River and to the Lower Watts Bar Reservoir are not a health hazard. Past and current exposures are below levels associated with adverse health effects and regulatory limits. Adults or children who have used, or might continue to use, the waterways for recreation, food, or dinking water are not expected to have adverse health impacts due to exposure. ATSDR has categorized those situations as posing *no apparent public health hazard* from exposure to radionuclides related to X-10."
46	Why doesn't ATSDR choose to give EPA, as its customer agency, a product here that EPA is demanding? Could it be that ATSDR is more interested in low-balling DOE's risk estimates by hacking out lower risk estimates by using the FDA 'millirem' vis-à-vis the PA PRGs? ATSDR should not go searching for some way out of 'discovering' that fishers downstream of WOC may be in harm's way. In fact, there may be serious potential human health effects from ingesting fish taken from many locations downstream of WOC. The citizens of Oak Ridge, Kingston, Spring City, and all other downstream communities from DOE ORR demand a better product from ATSDR, and one consistent with the legal requirements of CERCLA. (*Comment received on the initial release PHA dated December 2003.)*	Please refer to the response to comment 44 regarding the intentional differences between ATSDR's health assessments and EPA's risk assessments. In 1980, Congress established ATSDR, part of the U.S. Department of Health and Human Services, under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), also referred to as Superfund. This law was established so that funding would be available to identify and clean up hazardous waste sites throughout the country. While EPA and individual states regulate the investigation and clean up of the sites, since 1986 ATSDR has been required by law to conduct a public health assessment at each site on EPA's National Priorities List. Also to clarify, this commenter refers to ATSDR using "DOE's risk estimates" in this public health assessment, which is not true. This public health assessment uses data and doses from Task 4 of the Tennessee Department of Health's Reports of the Oak Ridge Dose Reconstruction (Task 4 report) and documents associated with the report to evaluate past exposures. For current exposures, ATSDR uses data collected from 1988 to 1994 as presented in ATSDR's 1996 *Lower Watts Bar Reservoir Health Consultation*, including environmental sampling data from the 1980s and 1990s that had been collected and assembled by DOE, TVA, and various consultants, as well as data from TVA's 1993 and 1994 annual radiological environmental reports for the Watts Bar Nuclear Plant. ATSDR also used data collected from 1989 to the present (2003) in the Oak Ridge Environmental Information System. For future exposures, ATSDR based its evaluation on current exposures and doses related to releases from White Oak Creek, data on current contaminant levels in the Clinch River and Lower Watts Bar Reservoir, institutional controls in place to monitor contaminants in these water bodies, and consideration of the possibility that remedial activities could release radionuclides to White Oak Creek. Thus, as required by law under CERCLA, ATSDR prepared a public health assessment to evaluate these various exposure scenarios. Using the data mentioned above, ATSDR calculated dose estimates for past, current, and future off-site exposures to X-10 radionuclide releases to the Clinch River and Lower Watts Bar Reservoir via White Oak Creek. Given ATSDR's independent evaluation, we determined that past, current, and future uses of these watersheds do not pose a health hazard for people who have used or

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		might continue to use these waterways for food, drinking water, or recreation.
47	Pages 120-121: ATSDR limits health outcome evaluation to disease occurrence in a population. ATSDR seems to ignore the fact that, even though the population around the Clinch River was not exposed to levels that would lead to a statistically significant increase in the number of disease cases, some individuals may have been subject to non-negligible risk. It is important that ATSDR quantify the risk of disease for different categories of individuals in addition to quantification of the risk in the population. Examples of such categories are: Anglers who fished close to White Oak Creek and who consumed relatively large amounts of the fish they caught. Children living in the area. Children are more radiosensitive than adults. This aspect has not been explicitly addressed in the SENES Oak Ridge, Inc., Task 4 Report. It would be useful for ATSDR to address this issue. Note that the exposures in the first two decades of releases (1944-1953 and 1954-1963) are significantly larger than exposures in the next two decades (1964-1973, 1974-1991), as described in the SENES Task 4 report.	Following the ATSDR Cancer Framework Policy, ATSDR does not perform risk assessments. The agency does however recognize the importance of EPA risk assessment and risk analysis to determine whether levels of chemicals at hazardous waste sites pose an unacceptable risk as defined by regulatory standards and requirements. Risk analysis also helps regulatory officials make decisions in support of cleanup strategies that will ensure overall protection of human health and the environment. ATSDR acknowledges that conservative safety margins are built into EPA risk assessments and that these assessments do not measure the actual health effects that hazardous chemicals at a site have on people. For additional information, please review the framework policy at http://www.atsdr.cdc.gov/cancer.html. Current ATSDR policy does not allow for the use of risk coefficients in determining public health impacts. The issue with applying a "quantitative" risk coefficient to any dose is that one can calculate any risk, and this is "perceived" as a true value. As stated in the ATSDR Cancer Framework Policy, "this artificial appearance of precision can lead decision makers to rely heavily on numerical risk estimates. Although ATSDR recognizes the utility of numerical risk estimates in risk analysis, the Agency considers these estimates in the context of the variables and assumptions involved in their derivation and in the broader context of biomedical opinion, host factors, and actual exposure conditions." The agency acknowledges that at present no single generally applicable procedure for exposure assessment is available, and therefore exposures to carcinogens must be assessed on a case-by-case or context-specific basis. For additional information, please review the framework policy at http://www.atsdr.cdc.gov/cancer.html. Nonetheless, for this PHA ATSDR added an appendix (Appendix F) to discuss risk terminology, radiation risk, and risk limits in detail. The appendix also explains the differences between ATSDR public health assessments and EPA risk assessments and shows the method for converting the doses in this PHA to risk numbers. Please note that ATSDR does not base its public health conclusions on these risk numbers; they are presented in this PHA only to provide for the community detailed risk information.
48	I was immediately concerned with the fact it appears that no uncertainty estimates are given on reconstructed doses and no information is given on the cancer risks of past exposure. Instead, the report makes simple comparisons against doses that ATSDR calls "cancer comparison values" that are given with the intent that they represent a dose level below which	ATSDR evaluated the need for an uncertainty analysis as outlined in NCRP Commentary 14 titled *A Guide for Uncertainty Analysis in Dose and Risk Assessments Related to Environmental Contamination.* In essence, the use of conservative and biased screening calculations indicated the possible resulting dose would be clearly below a regulatory limit. "Conservative screening calculations are designed to provide a risk estimate that is highly

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	there should be no public concern for past exposure to radiation. Our own past work in historic dose reconstruction at Oak Ridge has been misrepresented by ATSDR. It has failed to acknowledge the uncertainty in doses that we reconstructed for reference individuals and instead has chosen to focus only on median estimates. It has inappropriately averaged relatively high annual doses that occurred during the early years of operation over a lifetime of 70 years to give the impression that annual doses were merely small fractions of natural background. The implications of such uncertainties need to be forthrightly acknowledged by ATSDR, even if they consider the upper credibility limits to be conservative. Since ATSDR has not demonstrated that the parameters, and hence the dose distributions, derived in the Task 4 report were conservative, it is all the more critical that the PHA include this consideration.	unlikely to underestimate the true dose or risk. Therefore, a more detailed analysis will likely demonstrate that the true risk is even less." The document states that screening can be considered among the first steps in conducting an uncertainty analysis, as this roughly defines the upper and lower bounds of a distribution of exposed populations or individuals. If these screening calculations are to be used successfully, a decision point has to be determined to establish the boundary at which no further analyses are necessary. According to NCRP Commentary 14, "For example, for dose reconstruction, the National Academy of Sciences has suggested that an individual lifetime dose of 0.07 Sv be used as a decision criterion for establishing the need for more detailed investigation (NAS/NRC 1995 [National Research Council. 1995. Radiation dose reconstruction for epidemiologic uses. Committee on an assessment of CDC radiation studies. Board on Radiation Effects Research, Commission on Life Sciences. Washington, DC: National Academy of Sciences.])." A value of 0.07 Sv is equivalent to 7 rem or 7,000 mrem—a value that is 40% higher than ATSDR's radiogenic cancer comparison value of 5,000 mrem over 70 years. Thus, ATSDR's screening value is more conservative than the criteria suggested by the National Academy of Sciences as reported by the NCRP. For information on the difference between EPA risk assessment and ATSDR performing public health assessments, please see the response to comment 44. Further, for this PHA, ATSDR added an appendix (Appendix F) to discuss risk terminology, radiation risk, and risk limits in detail. The appendix also explains the differences between ATSDR public health assessments and EPA risk assessments and shows the method for converting the doses in this PHA to risk numbers. It is important to note that ATSDR does not base its public health conclusions on these risk numbers; they are presented in this PHA to provide for the community detailed information on risk. Use of the upper bound value artificially increases the risk, as the calculated uncertainty in many cases is at least an order of magnitude or greater than the 50th percentile value. ATSDR uses the central values in this public health assessment because they provide the most realistic doses for potential exposures to radionuclides in the Clinch River and Lower Watts Bar Reservoir. Central estimates are used because they describe the risk or dose for a typical, realistic individual. When considering central estimates, half of the potential doses will fall above and half will fall below the estimate. Therefore, an individual's actual dose would most likely be closer to the central value than near the high or low end of the range of dose estimates. In fact, ATSDR's external reviewers who evaluated documents associated with the Oak Ridge Dose Reconstruction recommended emphasizing the central estimate rather than the upper and lower bounds of the dose distribution. The method the commenter describes is a first approximation of the annual dose. This

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		method is generally used by many agencies, including the U.S. Environmental Protection Agency (EPA), the U.S. Department of Energy (DOE), and the U.S. Nuclear Regulatory Commission (NRC) in determining the accumulated dose in the first year following an intake. This issue was discussed at several Exposure Evaluation Work Group meetings (EEWG, formerly known as the Public Health Assessment Work Group [PHAWG]) and at the Oak Ridge Reservation Health Effects Subcommittee (ORRHES) meetings where the screening process was discussed. The reason for dividing the total dose by 48 years was to establish a first approximation of the dose, as this would allow for comparison to the 100 mrem/year dose limit recommended for the public by the ICRP, the National Council on Radiation Protection and Measurements (NCRP), the NRC, and ATSDR. ATSDR approximated the annual whole-body dose for each pathway by applying weighting factors to the Task 4's estimated 50th percentile organ-specific doses, adjusting for a 1-year exposure, and summing the adjusted organ doses across each pathway. The first approximation value of 4.0 mrem/year for past exposures is 25 times less than the 100 mrem/year dose limit recommended for the public. Because this approximated value is so much lower than the dose limit recommended for the public during the screening-level evaluation, no further actions were necessary. Had the approximation shown an annual dose close to 100 mrem/year, ATSDR would have re-assessed the evaluation and conducted further investigation. In the Task 4 report the authors state they used measured concentrations when available. If however, these data were not available, estimations were made via the use of modeled parameters. As discussed in Chapter 4 of the task report, these estimations were subjective probability distributions. Given the nature of the subjective analyses, ATSDR believes these to be conservative in nature and application. A quantitative uncertainty analysis, as discussed in NCRP Commentary 14, "usually requires that the state of knowledge about the uncertain components of the mathematical model be described by probability distributions." If this knowledge is unavailable, then professional judgment is used to evaluate the site-specific parameters. NCRP Commentary 14 also states that if the results of an assessment indicate that doses are below regulatory limits, then a quantitative uncertainty analysis may not be necessary. The Task 4 report used conservative parameters (similar to worst-case) to estimate risks and doses from past exposures to X-10 radionuclides released to White Oak Creek. ATSDR calculated doses using the findings of the Task 4 report and obtained estimated doses well below conservative, regulatory limits. NCRP Commentary 14 also states that following an uncertainty analysis, if the 95th percentile exceeds a standard or regulatory limit and the 50th percentile is less than the standard or regulatory limit, then additional evaluations may be recommended (page 23).

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		ATSDR performed this additional evaluation and concluded that the more reasonable result was that the doses received from the intake of potentially contaminated foods (i.e., the pathway yielding the highest doses) were below regulatory limits and below levels of a public health hazard. Even if doses from all other pathways evaluated were combined with the ingestion pathway, the doses were still sufficiently low and were below levels where tolerable and observable adverse health effects would be expected.
49	Reflecting on the Community Concerns and Communications Work Group (CCCWG) minutes for June 14, 2005, it is clear that further discussion on the subjects of criteria, the review of draft public health assessments, and the need for uncertainty analysis, is warranted and should be beneficial. In addition, the statement is made in NCRP Commentary 14 that the National Academy of Sciences (NAS) has suggested that an estimated individual lifetime (whole body) dose below which further investigation is not necessary is 7000 mrem.	ATSDR evaluated the need for an uncertainty analysis as outlined in the National Council on Radiation Protection and Measurements' (NCRP) Commentary 14 titled *A Guide for Uncertainty Analysis in Dose and Risk Assessments Related to Environmental Contamination.* In essence, the use of conservative and biased screening calculations indicated the possible resulting dose would clearly be less than a regulatory limit. "Conservative screening calculations are designed to provide a risk estimate that is highly unlikely to underestimate the true dose or risk. Therefore, a more detailed analysis will likely demonstrate that the true risk is even less." The PHA states that screening can be considered among the first steps in conducting an uncertainty analysis, as this roughly defines the upper and lower bounds of a distribution of exposed populations or individuals. If these screening calculations are to be used successfully, a decision point has to be determined to establish the boundary at which no further analyses are necessary. According to NCRP Commentary 14, "For example, for dose reconstruction, the National Academy of Sciences has suggested that an individual lifetime dose of 0.07 Sv be used as a decision criterion for establishing the need for more detailed investigation (NAS/NRC 1995 [National Research Council. 1995. Radiation dose reconstruction for epidemiologic uses. Committee on an assessment of CDC radiation studies. Board on Radiation Effects Research, Commission on Life Sciences. Washington, DC: National Academy of Sciences.])." A value of 0.07 Sv is equivalent to 7 rem or 7,000 mrem—a value that is 40% higher than ATSDR's radiogenic cancer comparison value of 5,000 mrem over 70 years. Thus, ATSDR's screening value is more conservative than the criteria suggested by the National Academy of Sciences as reported by the NCRP.
	There is a difference between a dose so low that a statistically significant epidemiological relative risk is not expected, and a dose below which the risk to the general public can be considered to be negligible. The failure of an epidemiological study to determine statistically significant relative risks is not sufficient to conclude "no health hazard" at lower doses. It is well understood amongst professionals in radiation epidemiology and radiation risk assessment that epidemiology by itself can never prove the null. For epidemiological investigations, a recommendation based on the	ATSDR recognizes that every radiation dose, action, or activity may have an associated risk. Given our evaluation in this public health assessment, ATSDR concludes that exposures to X-10 radionuclides released from White Oak Creek to the Clinch River and to the Lower Watts Bar Reservoir are not a health hazard. Past and current exposures are below levels associated with adverse health effects and regulatory limits. Adults or children who have used, or might continue to use, the waterways for recreation, food, or drinking water are not expected to have adverse health impacts due to exposure. ATSDR has categorized those situations as posing *no apparent public health hazard* from exposure to

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	highest dose attained, must take into account age at time of exposure, gender, and number of individuals exposed, uncertainty in exposure, and the inter-individual differences in exposure, before determining whether or not an epidemiological study will or will not have sufficient statistical power to detect an effect. For the ATSDR PHA, the risk below the limits of epidemiological detection should be disclosed with uncertainty. Anything else is censorship of information.	radionuclides related to X-10. This classification means that people could be or were exposed, but that their level of exposure would not likely result in any adverse health effects. But this public health assessment does not imply that an inability to detect effects is the same as no risk of exposure. This is clearly evident by the use of the *no apparent public health hazard* conclusion category in this public health assessment. ATSDR uses this category in situations in which human exposure to contaminated media might be occurring, might have occurred in the past, or might occur in the future, but where the exposure is not expected to cause any harmful health effects. Radiation exposure is possible; still, such exposure is not expected to result in observable and tolerable health effects. EPA-conducted risk assessments are useful in determining safe regulatory limits and prioritizing sites for cleanup. Risk assessments provide estimates of theoretical risk from possible current or future exposures and consider all contaminated media, regardless of whether exposures are occurring or are likely to occur. These quantitative risk estimates are not intended, however, to predict the incidence of disease or to measure the actual health effects in people resulting from hazardous substances at a site. By design, these risk estimates are conservative predictions that generally overestimate risk. Risk assessments do not provide a perspective on what the risk estimates mean in the context of the site community and do not measure the actual health effects that hazardous substances have on people. ATSDR uses the public health assessment process to evaluate the public health implications of exposure to environmental contamination and to identify the appropriate public health actions for particular communities. ATSDR scientists conduct a health effects evaluation 1) by carefully examining site-specific exposure conditions about actual or likely exposures; 2) by conducting a critical review of available toxicological, medical, and epidemiologic information to ascertain the substance-specific toxicity characteristics (levels of significant human exposure); and 3) by comparing an estimate of the amount of chemical exposure (i.e., dose) to which people might frequently encounter at a site to situations that have been associated with disease and injury. This health effects evaluation involves a balanced review and integration of site-related environmental data, site-specific exposure factors, and toxicological, radiological, epidemiologic, medical, and health outcome data to help determine whether exposure to contaminant levels might result in harmful effects. The goal of the health effects evaluation is to decide whether harmful effects might be possible in the exposed population by weighing the scientific evidence and by keeping site-specific doses in perspective. The output is a qualitative description of whether site exposure doses are of sufficient nature and magnitude to trigger a public health action to limit, eliminate, or further study any potential harmful exposures. The PHA presents conclusions about the

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		actual existence and level of the health threat (if any) posed by a site. It also recommends ways to stop or reduce exposures. For detailed information on risk, please see Appendix F in the final PHA. In this public health assessment, ATSDR compares annual doses to the 100 mrem/year dose limit of the International Commission on Radiological Protection (ICRP), the NCRP, and the U.S. Nuclear Regulatory Commission (NRC), as well as ATSDR's minimal risk level (MRL). ATSDR compares lifetime doses to the agency's radiogenic cancer comparison value of 5,000 mrem over 70 years, which is based on peer-reviewed literature and other documents developed to review the health effects of ionizing radiation. These values, used as screening tools during the public health assessment process, are levels below which adverse health effects are not expected to occur. If the screening indicates that past or current doses exceed our comparison values, then we would conduct further in-depth health evaluation. When ATSDR developed its screening values for radiation exposures, safety margins were incorporated. The approach ATSDR uses to derive MRLs, such as those in the Toxicological Profile for Ionizing Radiation, was developed with the U.S. Environmental Protection Agency (EPA). The screening value includes the use of a no observed adverse effect level (NOAEL) or a lowest observed adverse effect level (LOAEL) as well as three or more situation-specific uncertainty factors. When multiplied, these factors give a total uncertainty factor generally ranging from 1 to 1,000, based on the studies used. Furthermore, as discussed many times, the ATSDR legislative authority limits ATSDR to the evaluation of exposures based on observable and tolerable adverse health effects. If adverse health effects are not observed in an epidemiological study, then the doses used in the study should be considered tolerable. ATSDR's radiogenic comparison value of 5,000 millirem over 70 years incorporates the linear no-threshold (LNT) model for evaluating public health hazards associated with exposure to radiation. It assumes a total lifetime dose (70 years of exposure) above background that is considered safe in terms of cancer induction. In addition to the LNT model, ATSDR also incorporates a margin-of-dose (MOD) approach into this comparison value. During an evaluation, if ATSDR determines that further investigation is needed, it reviews scientific literature associated with radiological doses and dose estimates, particularly those related to adverse health effects. ATSDR then compares the dose estimates from scientific literature to site-specific dose estimates. Thus, ATSDR uses the LNT model to determine when a more detailed site-specific evaluation is necessary, and uses the MOD approach to develop realistic information for communities regarding what is known and unknown about radiation levels at a particular site.

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		An independent expert panel convened to review ATSDR's site-specific approaches used to evaluate past, current, and future radiation risks to communities surrounding the Oak Ridge Reservation concluded that this combination of approaches (LNT and MOD) is appropriate for ATSDR to use to determine radiation levels at which health effects actually occur. The panel found that ATSDR's use of the MRL of 100 millirem and radiogenic cancer comparison value of 5,000 millirem were appropriate screening values. If extrapolated over 70 years assuming constant exposure, the radiogenic cancer comparison value dose estimate would be about 71 millirem per year—a level the panel determined to be protective of public health in terms of cancer and noncancer risks. The panel also concluded that ATSDR's approach considers evidence for both individual organs and whole-body doses (effective doses), noting that a whole-body dose could not be developed without accounting for doses to single organs. Further, the panel determined that ATSDR's method of distinguishing dose levels from risk levels was acceptable because ATSDR incorporated risk and LNT explicitly and implicitly when calculating doses. In the words of one peer reviewer regarding ATSDR's radiogenic cancer comparison value, "The general consensus is that the linear non-threshold hypothesis is scientifically reasonable for the purpose of radiation protection. The recent NCRP comprehensive review and UNSCEAR [United Nations Scientific Committee on the Effects of Atomic Radiation] evaluations do not find any alternative model to be better, including one with a threshold. While epidemiology is not capable of detecting risks in the low dose domain, under say 10,000–20,000 millirem, there are cellular experiments and theoretical reasoning that support a linear response."
Discussion of Multiple Radionuclide and Pathway Exposures		
50	Page 6, Line 7: Are these doses added together for each route of exposure to obtain a cumulative dose for a person that may be exposed by consumption of ALL available aquatic species, PLUS game animals, swimming and sediment contact? Or is the method used something like this: each exposure is "dropped out" of the analysis if he/she doesn't exceed the threshold for that specific route of exposure and environmental media. This is important, because radiation doses ARE CUMULATIVE and an exposed individual will, in actuality, retain the additional dose from each route of exposure, even though its incremental calculation is "dropped out" for each separate exposure. Then, the sum of all 'sub-dangerous' individual does that he or she would sustain would, actually, exceed the EPA acceptable risk threshold of $1x10^{-4}$ (one extra case of cancer per	Past exposure pathways (see Table 11) included fish ingestion, drinking water ingestion, meat ingestion, milk ingestion, and external radiation via walking on sediment. For current exposure pathways for the Lower Watts Bar Reservoir, as presented in Table 16, ATSDR evaluated fish ingestion, water ingestion, contact with surface and dredged channel sediment, and swimming in, or showering with, surface water. For current exposure pathways for the Clinch River area, shown in Table 18, ATSDR evaluated ingestion of biota (i.e., fish, geese, and turtles), incidental ingestion of surface water, walking on sediment, and swimming. As explained in the Evaluating Exposures section of the final PHA (Section III.B.2. and III.B.3.), ATSDR calculated estimated annual and lifetime whole-body radiation doses for the Lower Watts Bar Reservoir and the Clinch River by **combining the pathways** evaluated (also see Table 22 and Table 23 the Public Health Implications section, Section IV.A.). To explain further, for its evaluation of past exposures, ATSDR applied weighting factors

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	10,000 potentially exposed individuals). (*Comment received on the initial release PHA dated December 2003.)*	(see Table 6 and page 68 of the final PHA) to Task 4 of the Tennessee Department of Health's Reports of the Oak Ridge Dose Reconstruction (Task 4 report) organ doses and summed the adjusted organ doses across pathways to derive the annual and whole-body doses for each pathway. ATSDR then summed the annual and whole-body dose for each pathway to derive the total annual dose to the whole body and the *committed effective dose* to the whole body over 70 years. ATSDR also summed the organ doses to derive a *committed equivalent dose* to an organ over a 70-year (lifetime) exposure. In its evaluation of current exposures for the Lower Watts Bar Reservoir, ATSDR derived whole-body (committed effective) doses for hypothetical people exposed to radionuclides through contacting surface and dredged sediment, swimming in or showering with surface water, ingesting surface water, or consuming fish. When deriving the doses, ATSDR used *worst-case* exposure scenarios, assuming that the most sensitive population—that is, young children—were exposed by the most likely exposure routes to the highest concentration of radionuclides in sediment, surface water, or fish: inhalation, dermal contact, and external radiation. In its evaluation of current exposures for the Clinch River, ATSDR examined incidental surface water ingestion, external radiation via walking on shoreline sediment or contacting water while swimming, and consumption of fish, geese, and turtles. For the dose assessment, ATSDR looked at the critical organ and the radiation dose delivered to the whole body. ATSDR concluded that past, current, and future exposures to radionuclides released from White Oak Creek to the Clinch River and Lower Watts Bar Reservoir are not a public health hazard for people who use these water bodies. Though people might have or might yet come in contact with X-10 radionuclides that entered the Clinch River or Lower Watts Bar Reservoir via White Oak Creek, ATSDR's evaluation of data for users of these waterways indicates that the levels of radionuclides in biota, sediment, and surface water are—and have been in the past—too low to cause observable health effects.
51	Page 84, Table 9. Summary of Estimated Organ-Specific (Equivalent) Radiation Doses For Past Exposure Pathways. ATSDR is supposed to use the standard 'slope factor' approach to ingested radionuclides (discussed previously in these comments), and not the 'millirem' approach. According to standard EPA Risk Assessment Guidelines (RAGs), ingested radionuclides are to be treated the same as all other chemical carcinogens and not to be cranked into the dated approach of simply comparing 'millirems of exposure to a hypothetical annual dose for an 'average' citizen. There is a good reason not to do this. The doses that citizens of	Please see the response to comment 44 regarding the policy on ATSDR performing health assessments—not risk assessments. For past, current, and future exposures to White Oak Creek radionuclide releases, ATSDR estimated maximum whole-body doses over a person's lifetime as well as annual whole-body doses for all radiation exposure pathways. Lifetime doses were compared to ATSDR's radiogenic cancer comparison value of 5,000 mrem over 70 years, which includes a linear no-threshold factor. In addition, all of ATSDR's dose calculations use the dose coefficients published in EPA's Federal Guidance Report 13, which are actually based on the

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	Oak Ridge, downwind, downstream, and down-aquifer from DOE ORR are IN ADDITION TO THE AVERAGE CITIZEN'S EXPOSURE. To simply compare these exposed individuals to that for the 'average' exposed individual deceitfully lowballs all radiation exposures these stakeholders are sustaining. Also, all of these radiation doses are CUMULATIVE and in addition to the 'average' dose they are already sustaining. This kind of inconclusive risk analysis is at best deceitful, if not downright malevolent. (*Comment received on the initial release PHA dated December 2003.)*	International Commission of Radiation Protection (ICRP) reports released after ICRP 60 that incorporate linear no-threshold and the dose coefficients. Estimated annual whole-body doses were compared to the dose of 100 mrem per year recommended for the public by ATSDR, the ICRP, the National Council on Radiation Protection and Measurements (NCRP), and the U.S. Nuclear Regulatory Commission (NRC). This 100 mrem/year recommended dose is based on exposures from all sources of radiation (including future sources), except for medical and background sources considered to be the annual background dose received each year by average U.S. citizens. These recommendations also conservatively assume that there is no threshold dose below which there are no health effects (a linear no-threshold model). The estimated doses presented in the table being referenced by the commenter (Table 11 in the final PHA) are above doses that people normally receive. Thus, these estimated doses are in addition to the average background received by U.S. citizens. The annual and lifetime doses calculated in this public health assessment include doses from all exposures and pathways combined. For past exposures for the Clinch River, the maximum whole-body dose over a lifetime (estimated committed effective dose of 278 mrem over 70 years) from all evaluated exposure pathways is well below (18 times less than) ATSDR's radiogenic cancer comparison value. Doses below this value are not expected to result in observable health effects. Radiation lifetime doses to critical organs (e.g., bone, lower large intestine, red bone marrow, breast, and skin) are also less than ATSDR's comparison values. For current exposures for Lower Watts Bar Reservoir, ATSDR estimated committed effective doses (whole-body doses occurring over a lifetime, or 70 years) for exposures to radionuclides by contacting shoreline or dredged sediment, swimming in or showering with surface water, ingesting surface water, or eating fish. ATSDR's committed effective dose to the whole body for all pathways combined is less than 1,900 mrem over 70 years—2.5 times below ATSDR's radiogenic CV of 5,000 mrem over 70 years. The estimated annual whole-body dose is less than 30 mrem, which is below (3 times less than) the dose of 100 mrem per year recommended for the public by ATSDR, ICRP, NCRP, and NRC. For current exposures for the Clinch River, ATSDR's estimated committed effective dose to the whole body for all pathways combined is less than 240 mrem—more than 20 times below ATSDR's radiogenic CV of 5,000 mrem. The estimated annual whole-body dose is less than 3.4 mrem—about 30 times below ATSDR's screening CV and about 30 times below ICRP's, NCRP's, and NRC's recommended value for the public of 100 mrem/year. Therefore, ATSDR concludes that past, current, and future uses of these watersheds would not pose a health hazard for people exposed to White Oak Creek radionuclide releases. As

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		demonstrated throughout the PHA and as detailed in this response, estimated exposure doses are below levels at which adverse health effects have been observed, even when taking into account the background radiation dose already received annually by average U.S. citizens.
52	Radionuclides are not the only contaminants of concern in White Oak Creek, the Clinch River, or the Lower Watts Bar Reservoir. As noted in Sect. III. A, the ATSDR previously prepared a PHA on uranium releases from the Y-12 Plant and is planning to conduct one on PCB releases from ORNL, the Y-12 Plant, and the K-25 site. There is considerable evidence that risks for some radiogenic cancers (e.g., breast cancers) are additive with those associated with other factors (see, e.g., Annex I in the UNSCEAR 2000 report). Thus, an assessment that evaluates each type of contaminant in isolation, i.e., without considering their combined effects, may significantly underestimate the total risk. This concern should be acknowledged in the revised report.	After completing each individual public health assessment, ATSDR will be evaluating potential health effects from multiple chemical and radiological exposures.
Data and Modeling		
53	Page 2, Line 13: "radionuclides from White Oak Creek." High levels of these specific radionuclides have been earmarked in the OREIS (Oak Ridge Environmental Information System) database for decades. OREIS is not now readily available to the general public, but it is readily available to State of Tennessee scientists and public health officials. Many citizens also hold archives of these environmental releases from the time before DOE limited access to it. DOE's own sampling data, especially from its key fish sampling locations has been carefully archived for decades and these data confirm high levels of Cs-137 and Sr-90 and other radionuclides and fish tissue in many locations downstream of WOC. ATSDR should immediately get access to the OREIS database, confirm these findings, and release this information to the public. (*Comment received on the initial release PHA dated December 2003.)*	ATSDR has access to and has obtained data in electronic format from the Oak Ridge Environmental Information System (OREIS) (as mentioned throughout the final PHA; OREIS is detailed in Section II.F.4.). ATSDR used the OREIS data covering the time period from 1989 to 2003 to evaluate the current and future exposures and doses related to radionuclide releases from White Oak Creek. Samples included surface waters collected from the Lower Watts Bar Reservoir and sediments from the associated shorelines. ATSDR also evaluated biota data, including fish, geese, and turtle samples. ATSDR analyzed samples for rivers in the watershed that included the Clinch River below Melton Hill Dam and the Tennessee River below the mouth of the Clinch River. For comparison purposes, ATSDR reviewed data collected from background locations (Emory River, streams that feed into the Clinch River, the Clinch River above the Melton Hill Dam, and the Tennessee River upstream of the Clinch River). In addition, ATSDR evaluated data from the Tennessee Department of Environment and Conservation (TDEC) and the Tennessee Valley Authority (TVA), and used doses calculated in Task 4 of the Tennessee Department of Health's Reports of the Oak Ridge Dose Reconstruction (Task 4 report) to evaluate past exposures. When initially sorting the data, ATSDR included the radionuclides associated with the Task 4 report, as well as the radionuclides reported in the OREIS data. The purpose of the data sorting was to collate data by the following parameters: river location, species (for biota), radionuclide, or a combination of one or more of these parameters. As a result of this sorting, ATSDR performed its evaluation on the radionuclides presented in Table 17 of the

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		final PHA. As shown in this table, OREIS data for cesium 137 and strontium 90, as well as cobalt 60, yttrium 90, americium 241, and hydrogen 3 were evaluated. ATSDR's estimated doses for current and future exposures to radionuclides from White Oak Creek based on these OREIS data were below levels shown to cause adverse health effects. Accordingly, ATSDR concluded that these current and future exposures are not a health hazard.
54	Page 4, Line 4: "ATSDR determined that the levels of radioactive contaminants that entered the Clinch River, and as well as those that reached the downstream Lower Watts Bar Reservoir, are too low to cause observable adverse health effects for most people who used or continue to use the river for food or recreation." This statement cannot be supported by publicly available information from both DOE itself (documented in the OREIS database, the technical information that supports the DOE ORR's own ASER (Annual Site Environmental Report), and scientific reports of fish tissue content available from the TVA (Tennessee Valley Authority). ATSDR's failure to adequately explore the publicly available data for decades of fish tissue analyses both on the Reservation and downstream is blatantly irresponsible. (*Comment received on the initial release PHA dated December 2003.)*	In the PHA, "ATSDR concluded that past, current, and future exposures to radionuclides released from White Oak Creek to the Clinch River/Lower Watts Bar Reservoir are not a public health hazard. People who used or lived along the Clinch River or Lower Watts Bar Reservoir in the past, or who currently do so or will in the future, might have or might yet come in contact with X-10 radionuclides that entered the Clinch River or Lower Watts Bar Reservoir via White Oak Creek. However, ATSDR's evaluation of data and exposure situations for users of these waterways indicates that the levels of radionuclides in the sediment, surface water, and biota are—and have been in the past—too low to cause observable health effects." As part of ATSDR's public health assessment process, we conducted a thorough search for available data to evaluate exposures to White Oak Creek radionuclide releases via biota, sediment, and surface water. For past exposure, ATSDR reviewed and evaluated Task 4 of the Tennessee Department of Health's Reports of the Oak Ridge Dose Reconstruction (Task 4 report) and documents associated with this report. The Task 4 team performed extensive searches to obtain data for X-10 radionuclide releases to the Clinch River via White Oak Creek during the time period 1944 to 1991. The Task 4 team based its quantity estimates on log books, interviews with personnel associated with collecting samples and monitoring radioactive releases from White Oak Dam, and laboratory documents. For current and future exposures for the Lower Watts Bar Reservoir, ATSDR evaluated data collected from 1988 to 1994 as presented in ATSDR's 1996 *Lower Watts Bar Reservoir Health Consultation.* For the Lower Watts Bar Reservoir, this incorporated environmental monitoring data for surface and deep channel sediment, surface water, and local biota (including fish) collected from the Lower Watts Bar Reservoir by DOE and TVA during the 1980s and 1990s. For current and future exposures for the Clinch River, data were obtained from the Oak Ridge Environmental Information System (OREIS). OREIS contains data from all key surveillance activities and environmental monitoring efforts, including annual site summary reports and studies of the Clinch River and the Lower Watts Bar Reservoir. The data received and analyzed by ATSDR covered the time period from 1989 to 2003. Samples included surface waters collected from the Lower Watts Bar Reservoir and sediments from the associated shorelines. ATSDR also evaluated biota data that included fish, geese, and turtle samples. ATSDR analyzed samples for rivers in the watershed that

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		included the Clinch River below Melton Hill Dam and the Tennessee River below the mouth of the Clinch River. For comparison, ATSDR also reviewed data collected from OREIS for background locations (Emory River, streams that feed into the Clinch River, the Clinch River above the Melton Hill Dam, and the Tennessee River upstream of the Clinch River). In addition, ATSDR presented the data sources to be used to the former Public Health Assessment Work Group (PHAWG), later referred to as the Exposure Evaluation Work Group (EEWG), to determine whether any additional data sources were available. This information was also shared with the Oak Ridge Reservation Health Effects Subcommittee, as well as with state and federal agencies (i.e., the U.S. Department of Energy [DOE], the Tennessee Department of Environment and Conservation [TDEC], and the Tennessee Department of Health [TDOH]).
55	Page 39, Lines 1–2. Again, ATSDR's Watts Bar is fundamentally flawed because ATSDR did not account for DOE's own fish sampling data in OREIS. ATSDR cannot reconcile this BRA with these fish sampling data that exist for downstream communities from at least 1985. (*Comment received on the initial release PHA dated December 2003.)* Page 38, Line 10. Please see the TWRA website for (Tennessee Wildlife Resources Agency) fish advisories for Watts Bar and other locations downstream: http://www.state.tn.us/twra/fish/contaminants.html. If ATSDR had even visited this website it would quickly learn that the fish consuming citizens of Tennessee are not even informed about their fish being contaminated with Sr-90, Cs-137, and other radionuclides released from DOE ORR. This amounts to a deliberate and unconscionable attempt to cover-up the fact that the fish in the TVA system have been and continue to be radioactively contaminated. This denial of these stakeholders fundamental right-to-know borders on conspiracy to obstruct justice. (*Comment received on the initial release PHA dated December 2003.)* Many citizens downstream of the DOE ORR are particularly concerned that the State of Tennessee has yet to inform its citizens of the real risks that they are sustaining from consuming fish collected in tributaries leaving the DOE ORR. Although the State of Tennessee has posted a fish advisory for PCBs on its website, there is not one mention of these fish also being contaminated with radionuclides, especially high levels of Cesium 137 (Cs-137) and Strontium-90 (Sr-90). This inability for the State of Tennessee to inform its citizens that these fish are also radioactively contaminated is unconscionable. ATSDR should, and must, take	This referenced statement of the document—"The largest threat to public health from the Lower Watts Bar Reservoir is related to the consumption of PCB-contaminated fish."— does not refer to the U.S. Department of Energy's (DOE) baseline risk assessment as indicated by the commenter, but to the record of decision (ROD) for the Lower Watts Bar Reservoir (accessible online at http://www.epa.gov/superfund/sites/rods/fulltext/r0495249.pdf). This finding in the ROD is based on the conclusions of the baseline risk assessment, which determined that standards for environmental and human health would not be reached if people consumed moderate to high quantities of specific fish that contained increased levels of PCBs. The ROD is agreed to by the three members of the Federal Facility Agreement (FFA): DOE is the lead agency that issued the ROD, and the U.S. Environmental Protection Agency (EPA) and the Tennessee Department of Environment and Conservation (TDEC) are supportive agencies. In a 1996 health consultation, ATSDR conducted an independent analysis of the Lower Watts Bar Reservoir data to evaluate whether radiological and chemical contaminants in reservoir fish, surface water, and sediment posed a public health hazard. ATSDR concluded that PCB levels in fish were the only contaminants that posed a public health hazard. ATSDR determined that no public health hazards were associated with the three primary radioactive contaminants (cesium 137, cobalt 60, and strontium 90) in reservoir fish and that current levels of chemical and radiological contaminants in reservoir surface water and sediment did not pose a public health hazard. To evaluate current and future exposures for the Clinch River and the Lower Watts Bar Reservoir, ATSDR did obtain and evaluate biota, surface water, and sediment sampling data from OREIS from 1989 to 2003 in this final PHA. ATSDR determined that radionuclides in fish, sediment, and surface water do not pose a health hazard for people who used and continue to use the Clinch River and the Lower Watts Bar Reservoir. Therefore, even

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	immediate action to issue a public health advisory warning people of the danger. The State of Tennessee should, and must, immediately post this information (that it has known about for decades) on its fish advisory website, and immediately change all affected stream signage to reflect this warning. At each and every location where it has already posted its PCB warnings, it must also specify the risks from radionuclides, especially Cs-137 and Sr-90. These two radionuclides are particularly dangerous to growing children and pregnant women. (*Comment received on the initial release PHA dated December 2003.)*	though radionuclides might be present in the Clinch River and the Lower Watts Bar Reservoir, only PCBs in certain fish species have been found at levels that might cause adverse health effects. TDEC's Division of Water Control is responsible for issuing and posting fish advisories. Evaluating fish tissue problems in the state of Tennessee involves a multi-agency effort, comprised of DOE, EPA, TDEC, the Tennessee Wildlife Resources Agency (TWRA), and the Tennessee Valley Authority (TVA). An abundance of data are available on contaminants in fish in these systems, including data collected by TVA, DOE, TWRA, and TDEC. These agencies use Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) criteria to analyze fish tissue in these waterways, which applies EPA risk assessment to evaluating potential exposures to contaminants in fish. DOE, TDEC, and EPA have responsibilities under CERCLA, but the state has ultimate responsibility for the advisories. The state fish advisories are available at: http://www.state.tn.us/twra/fish/contaminants.html. It is important to understand that although there might be radionuclides and other contaminants present in fish in the Clinch River and the Lower Watts Bar Reservoir, **only PCBs** have been found at levels in particular species of fish that could potentially cause adverse health effects. This is why radionuclides are not part of the advisories for these waterways—they have not been detected at harmful levels in these water systems. These agencies are basing their advisories on numerous data collected over several years by different entities, all of which show that radionuclides are not present in fish in the Lower Watts Bar Reservoir and the Clinch River at levels that could cause adverse health effects. ATSDR's evaluation in this public health assessment concurs with the findings of the state, EPA, and these other entities. In addition, ATSDR is preparing a public health assessment that will evaluate PCB releases from the three main ORR facilities: X-10, Y-12, and K-25. When available, copies of ATSDR's public health assessment on PCBs can be obtained by contacting ATSDR's Information Center toll-free at 1-888-422-8737. As a public health agency, ATSDR could make recommendations for public health actions if our evaluation showed that radionuclides in the Lower Watts Bar Reservoir and the Clinch River posed a potential health hazard for people living along and using these waterways. For past exposures to X-10 radionuclide releases via the Clinch River, estimated annual and lifetime whole-body radiation doses for all pathways combined were 25 and 18 times less, respectively, than health-based comparison values. For current exposures to the Lower Watts Bar Reservoir, estimated annual and lifetime whole-body radiation doses for all pathways combined were 3 and 2.5 times less, respectively, than health-based comparison values. For current exposures to the Clinch River, estimated annual and lifetime whole-body radiation doses for all pathways combined were 30 and 20 times less than, respectively,

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		ATSDR's health-based comparison values. Therefore, based on an analysis and evaluation of data in our 1996 health consultation and in this public health assessment, we have concluded that exposure to X-10 radionuclides released from White Oak Creek to the Clinch River and the Lower Watts Bar Reservoir via biota, surface water, and sediment is not a public health hazard. Please see the final PHA for more details on ATSDR's evaluation.
56	Page 76, line 28: Mathematical modeling was used to estimate the annual average concentrations of the radionuclides in water and sediment downstream from White Oak Creek. We used actual measurements in water, when available, to calculate doses.	Thank you for your comment. The following text was added to the final PHA: "To calculate doses for Cs 137, Sr 90, Ru 106, and Co 60, the Task 4 team used—when available—actual measurements from the Clinch River water it collected 1960–1990 at CRM 14.5 (K-25 Grassy Creek) and at 4.5 (Kingston Steam Plant). For the remaining radionuclides and for time periods when data were unavailable, the Task 4 team used modeling to estimate the historical radionuclide concentrations in Clinch River water."
57	Page 90, Table 13. Maximum Radionuclide Concentrations in Lower Watts Bar Reservoir Area Fish. Page 99; Table 19. Estimated Radiation Doses From Current Consumption of Geese and Turtle. Page 100; and Table 20. Estimated Radiation Doses From Current Consumption of Fish. This information is not factual. DOE's own fish sampling data in its ACER data volumes are in excess of these levels. ATSDR and all interested stakeholders can easily access these data at: http://www.ornl.gov/sci/env_rpt/. To get the desired data volume the stakeholder needs to scroll down the index and the data bookmark is typically near the bottom for each year. These data volumes provide a wealth of additional data that most will be very interested in as well! ATSDR needs to do a better job on its homework in obtaining the same additional, publicly available data sets that interested downstream, downwind, and down-aquifer stakeholders are already using to do their own competing risk analyses. Page 102, Table 21. Summary of Public Health Implications From ATSDR's Evaluation of Past and Currently Exposure to Radionuclides Released to the Clinch River/Lower Watts Bar Reservoir. There are over 150 species of fish and other aquatic animals that dwell in the Clinch River, and many are used for food. Some of the available organisms from the Clinch River and TVA's reservoirs are not included in this PHA are crayfish and frogs. Nevertheless, DOE ORR has radiological sampling data in the OREIS database on all of these. There is no paucity of extensively archived and publicly available data	The former Table 13 being referenced by the commenter is now Table 15 in the final PHA. The information presented in this table is based on data collected from 1988 to 1994 as presented in ATSDR's 1996 *Lower Watts Bar Reservoir Health Consultation*, including environmental sampling data from the 1980s and 1990s that had been collected and assembled by the U.S. Department of Energy (DOE), the Tennessee Valley Authority (TVA), and various consultants. Also, ATSDR analyzed data from TVA's 1993 and 1994 annual radiological environmental reports for the Watts Bar Nuclear Plant. Thus, the data contained in this table are inclusive of data collected by DOE during the time periods of study. For the health consultation, ATSDR analyzed chemical and radiological data in surface water, sediment, and fish. ATSDR evaluated potential exposures by using worst-case scenarios assuming the most sensitive population was exposed to the maximum concentrations of each contaminant in each media. ATSDR concluded that exposure to radionuclides detected in Lower Watts Bar Reservoir fish, surface water, and sediment was not a public health hazard. Again, as noted previously, these conclusions were based on available data not only collected from DOE, but also from TVA and from various consultants. In the final PHA, the referenced former Tables 19 and 20 are now Table 19. Estimated Radiation Doses From Current Ingestion of Fish and Table 20. Estimated Radiation Doses From Current Ingestion of Geese and Turtles. The radiation doses presented in Table 19 and Table 20 are based on an evaluation of data collected from the Oak Ridge Environmental Information System (OREIS). When calculating the doses, ATSDR used the concentration of the radionuclides in the environment, and site-specific factors if they were available, such as the amount of fish consumed based on ATSDR's 1998 Watts Bar Reservoir exposure investigation. Default values were used when site-specific factors were

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	regarding the radionuclide content of an immense array of other aquatic organisms (or their consumers) that people in the TVA region consume as well. For example, there are extensive archives of radionuclide contents of the following: turtles, mussels, crayfish, raccoons, beaver, and many others. ATSDR must come to grips with the publicly available sampling data. Thereafter is must apply standard EPA risk assessment methodologies to these voluminous data. Instead of trying to find ways not to find and evaluate the immense volumes of publicly available data confirming the existence of threats to the public health, downwind and downstream of the DOE ORR, ATSDR must start now and evaluate the levels of these radionuclides in fish and other biota used as food by the many residents downstream. Since many of these radioactively contaminated fish definitely don't remain 'in residence' near WOC, but could range far and wide throughout the TVA system, this PHA is definitely over simplistic and is lulling stakeholders into a false sense of security when it deals with fish consumption. (*Comments received on the initial release PHA dated December 2003.)*	not available, such as for drinking water ingestion. These two tables present estimated whole-body doses, as well as doses for the critical organs—those organs receiving the highest radiation doses. OREIS consists of data from all key surveillance activities and environmental monitoring efforts associated with the Oak Ridge Reservation operations, including DOE's annual site environmental reports (ASERs). When initially sorting the data, ATSDR included the radionuclides associated with Task 4 of the Tennessee Department of Health's Reports of the Oak Ridge Dose Reconstruction (Task 4 report), as well as the radionuclides reported in the OREIS data. The purpose of the data sorting was to collate data by the following parameters: river location, species (for biota), radionuclide, or a combination of one or more of these parameters. As a result of this sorting, ATSDR performed its evaluation on the radionuclides presented in Table 17 of the final PHA. As shown in this table, OREIS data were evaluated for cesium 137, strontium 90, cobalt 60, yttrium 90, americium 241, and hydrogen 3. ATSDR conducted a thorough search for available data to determine whether exposure to White Oak Creek radionuclide releases were and are a public health hazard for people who used and continue to use the Clinch River and the Lower Watts Bar Reservoir. For past exposure, ATSDR reviewed and evaluated the Task 4 report and documents associated with this report. The Task 4 team performed extensive searches to obtain data for X-10 radionuclide releases to the Clinch River via White Oak Creek during the time period 1944 to 1991. The Task 4 team focused its information collection activities on records at the X-10 Laboratory Records (containing "active" types of records, such as technical reports and memorandums regarding X-10 activities) and the X-10 Records Center (containing more "archived" types of records). The Task 4 team based its quantity estimates on various sources utilized during data collection activities, including log books, interviews with personnel associated with collecting samples and monitoring radioactive releases from White Oak Dam, and laboratory documents. For current and future exposures for the Lower Watts Bar Reservoir, ATSDR evaluated data collected from 1988 to 1994 as presented in ATSDR's 1996 *Lower Watts Bar Reservoir Health Consultation.* For the Lower Watts Bar Reservoir, this incorporated environmental monitoring data for surface and deep channel sediment, surface water, and local biota (including fish) collected from the Lower Watts Bar Reservoir by DOE and TVA during the 1980s and 1990s. For current and future exposures for the Clinch River, data were obtained from OREIS. The data received and analyzed by ATSDR covered the time period from 1989 to 2003. Samples included surface waters collected from the Lower Watts Bar Reservoir and sediments from the associated shorelines. ATSDR also evaluated biota data that included fish, geese, and turtle samples. ATSDR analyzed samples for rivers in the watershed that included the Clinch River below Melton Hill Dam and the Tennessee River

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		below the mouth of the Clinch River. For comparison, ATSDR also reviewed data collected from OREIS for background locations (Emory River, streams that feed into the Clinch River, the Clinch River above the Melton Hill Dam, and the Tennessee River upstream of the Clinch River). Contrary to this commenter's statements, the OREIS database does not contain radiological sampling data for the "over 150 species of fish and other aquatic animals that dwell in the Clinch River." Reportedly, the Clinch River Valley actually maintains over 350 different species of wildlife. Data contained in OREIS from 1989 to 2003, however, only include radiological sampling data for the areas of study and radionuclides of interest (see Table 17 in the final PHA) for the following species in the Clinch River known as food sources: fish (bass, catfish, and sunfish), geese, and turtles. ATSDR evaluated available sampling data for these particular species for the study areas and radionuclides of interest (see Table 17), as well as on the known exposure pathways to these wildlife. Data for the radionuclides and areas of interest were available for fish in the Clinch River and the Lower Watts Bar Reservoir for past and current exposures, as well as for geese and turtles in the Clinch River for current exposures. No radiological data are contained in OREIS for 1989 to 2003 for other wildlife species in these areas of study known as food sources, including crayfish or frogs (as specifically requested by the commenter). Particular to this commenter's list, data for turtles were available and evaluated in Section III.B.3. of the final PHA for current exposures to the Clinch River. Mussels are detailed in the PHA (see Section III.B.3) regarding the Clinch River, and how the likelihood is low that people consumed mussels from the Clinch River. Data for the remaining species on the commenter's list, as well as additional species, were not evaluated because the data are not available for the radionuclides of interest and the study area of interest, or people are not known to consume the particular species. ATSDR not only looked at fish remaining near White Oak Creek, ATSDR evaluated fish data for the entire White Oak Creek study area, consisting of the area along the Clinch River from the Melton Hill Dam to the Watts Bar Dam. Section III. Evaluation of Environmental Contamination and Potential Exposure Pathways in the final PHA details ATSDR's analysis of past, current, and future exposures to White Oak Creek radionuclide releases via consumption of fish and other biota. Section IV. Public Health Implications details the weight-of-evidence approach ATSDR used to compare estimated radiation doses to situations associated with disease and injury to determine whether harmful health effects could be possible and observable. Using our evaluation, ATSDR determined that the levels of radionuclides in biota, sediment, and surface water were too low to cause observable health effects. Accordingly, ATSDR concluded that past, current, and future exposures to radionuclides released from White Oak Creek to the Clinch River and the

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		Lower Watts Bar Reservoir are not a public health hazard for people who lived along or used these waterways in the past, present, and future. Regarding ATSDR applying EPA risk assessment methodologies, please refer to Appendix F in the final PHA and the response to comment 44 within this appendix.
Accuracy/Clarification of Statements		
58	Page 20, Table 2. Estimated Discharges (in curies) of Radionuclides from White Oak Creek. This table is busy and seems to hide information instead of revealing the nature and extent of radioactive discharges from White Oak Creek. Is this obfuscation by design on ATSDR's part? Page 13, Line 22. Thorium and plutonium releases are detailed in the OREIS database. These two extremely long-lived radionuclides should be cited in Table 2 and Table 3, but are conspicuously absent. Was ATSDR's omission of thorium and plutonium from these two tables purposeful? (*Comments received on the initial release PHA dated December 2003.)*	Table 2 in the final PHA was taken directly from the *Remedial Investigation/ Feasibility Study of the Clinch River/Poplar Creek Operable Unit* prepared by Jacobs Engineering Group Inc. in 1996. It is available at http://www.osti.gov/bridge/servlets/purl/226399-5omhIT/webviewable/226399.pdf. The table presents the estimated discharges (in curies) for only those radionuclides released from White Oak Creek to the Clinch River that required investigation. It contains the radionuclides, the year of release, and the estimated discharges in curies. We believe that this table provides useful information for the reader. Table 3 in the final PHA was taken directly from the Tennessee Department of Health's Oak Ridge Dose Reconstruction Summary Report available at http://www2.state.tn.us/health/CEDS/OakRidge/ProjSumm.pdf. This was based on the Task 4 report titled *Radionuclide Releases to the Clinch River from White Oak Creek on the Oak Ridge Reservation—an Assessment of Historical Quantities Released, Off-site Radiation Doses, and Health Risks*. The Task 4 team identified 24 radionuclides during its screening assessment that had been released to the Clinch River via White Oak Creek from 1944 to 1991. Among this group of 24 radionuclides were thorium and plutonium. Using a risk-based screening process, however, 16 of the radionuclides were eliminated because the estimated screening indices were below the Task 4 team's minimal level of concern (1×10^{-5}). Both plutonium and thorium were removed from further evaluation because the releases of the contaminants to the Clinch River via White Oak Creek were below the team's minimal level of concern. Therefore, to be clear, these tables were created by entities other than ATSDR, but we did review their work prior to including it in this public health assessment. Also, please note that there are many radionuclides in OREIS other than thorium, plutonium, and those presented in these tables. Thorium and plutonium, as well as other radionuclides, are not presented in these tables because their releases to the Clinch River via White Oak Creek have not been found at levels of concern and at levels requiring further investigation. See Appendix D for a brief on the 1999 Task 4 report. Copies of the Task 4 report are available at the DOE Information Center located at 475 Oak Ridge Turnpike, Oak Ridge, Tennessee (telephone number: 1-865-241-4780) or at http://www2.state.tn.us/health/CEDS/OakRidge/WOak1.pdf.

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59	He questioned the PHA's statement (on page 16, line 7) that the X-10 facility still produces isotopes.	According to the Tennessee Department of Environment and Conservation's (TDEC) 2004 Status Report to the Public (available at http://www.local-oversight.org/TDEC2004.pdf, see pages 14–15) and the U.S. Department of Energy (DOE), the High Flux Isotope Reactor (HFIR) and the Radiochemical Engineering and Development Center (REDC) are active facilities at the Oak Ridge National Laboratory (ORNL), formerly known as X-10, used for the production of medical and industrial isotopes. For more information, see the Web sites for the HFIR facility (http://web.ornl.gov/sci/rrd/pages/hfir.html), and the REDC (http://www.ornl.gov/sci/nuclear_science_technology/redc/).
60	P. 27. The statement about designs lacking, "adequate containment structures", taken from the Oak Ridge End Use Working Group (EUWG) report, reveals an inadequate understanding of hydrogeologic design on the part of the EUWG. How would they design a septic tank drain field? Any sort of impervious barrier would simply lead to flooding and stop the process. Furthermore, the comment about, "improper design", appears not to be a quote from, but rather an inaccurate and unjustified addition to, the wording of the EUWG report. This phrase should be deleted. The trenches functioned as natural electrostatic filters. They were not improperly designed.	In the final PHA the text has been changed to the following: "Radioactive waste material, such as Cs 137 and Sr 90, is present in old waste sites at the ORR. These waste sites constitute 5% to 10% of the reservation. Releases from these waste sites, as well as leaching caused by abundant rainfall and high water tables, have contributed to the radionuclide contamination of surface water, groundwater, soil, and sediments at the ORR."
61	Page 34 Line 18: The largest concentrations of radionuclides that have been detected are buried between 8 and 32 inches into the deep sediments; radionuclide contamination has not been detected in the shoreline sediment (Jacobs EM Team 1997b). Radionuclides have been reported in shoreline sediments of the Clinch. Consequently, the above statement appears to be incorrect.	Thank you for the clarification. This information was obtained from the Clinch River/Poplar Creek record of decision that states, "Those few DOE-related contaminants above background levels in the near-shore sediments are arsenic in McCoy Branch, and chromium and manganese in Poplar Creek." The correction will be made to reflect this updated information.
62	Page 34, Line 27. Has any treatment of these wastes actually occurred yet, or are they still residing in place at the MVSTs? In other words, specifically state here which, if any, fraction of these wastes have actually been removed and treated, and which fraction remains in situ. If in fact, the wastes still remain in place this passage is misleading to the reader and gives the public a false sense of 'security' that these stored wastes, in leaking concrete containers, are being 'remediated.' The citizens of Oak Ridge and all downstream and down-aquifer deserve a straight answer from ATSDR. (*Comment received on the initial release PHA dated*	The Melton Valley Storage Tanks (MVSTs) consist of eight underground storage tanks (USTs) each with an approximate 50,000-gallon capacity, located in Melton Valley. The MVSTs are used to store transuranic (TRU) waste from past processes and remedial activities, including the old hydrofracture facility (OHF) tanks referenced by the commenter (see Appendix B in the final PHA for more information on the OHF tanks). First of all, it is important to note that contrary to the commenter's statement, the OHF tanks were not leaking. In fact, the waste was moved to the MVSTs for safer storage of wastes remaining in the tanks before treatment took place and before any of the tanks could potentially leak. Because there were concerns about the proximity of the tanks to White Oak

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	December 2003.)	Creek, the potential threat to environmental receptors, and the **possibility** of tank leakage, an action memorandum was prepared in September 1996 to move and treat the tank waste. The memorandum outlined an aboveground, double-walled hose system to transfer the tank contents and waste to the MVSTs. Prior to the transfer, some treatment of the waste occurred so that the waste would meet the waste acceptance criteria for the MVSTs. From June to July 1998, more than 98% of the waste was moved through a pipeline to the MVSTs, where additional treatment will occur. Another action memorandum for the OHF, prepared in May 1999, focused on tank stabilization and on the surface impoundment sediments associated with the OHF. The tank stabilization activities included removing the piping system, placing submersible pumps into the tanks, using mixer spool pieces, and grouting the tanks. For the surface impoundment, the remedial activities consisted of applying grout for sediment stabilization, placing grout into standpipes, removing excess water, treating any excess water at the Process Water Treatment Plant (PWTP), and using filler material to replenish the impoundment. These remedial activities were completed, and in May 2001 a removal action report was released. Waste to be treated at the ORR's Transuranic Waste Processing Facility is still being stored or consolidated in the MVSTs. After the TRU waste is treated, it will be shipped off site for disposal at the Waste Isolation Pilot Plant in Carlsbad, New Mexico. Processing of the waste is underway and completion of off site disposal is expected to occur in 2008.
63	P. 57. Line 19. Do you really mean Cr (VI) at all three ORR sites when you state "ORR?"	Yes, this statement is correct as presented in the PHA. Hexavalent chromium was used in cooling towers at K-25, Y-12, and X-10. Please refer to Sections 5.4 (Hexavalent Chromium Releases from the Oak Ridge Reservation) and 7.0 (Conclusions) in Task 7 of the Reports of the Oak Ridge Dose Reconstruction titled *Screening-Level Evaluation of Additional Potential Materials of Concern*. The report is available online at http://www2.state.tn.us/health/CEDS/OakRidge/Screen.pdf.
64	P. 72 (and Appendix E). Shouldn't the term "screening index" be identified as being a calculated probability, or risk?	An explanation that a "screening index" is a calculated probability of developing cancer has been added to the summary, page 77, and to Appendix E. In addition, the term "screening index" was added to and defined in the glossary in Appendix A.
65	Page 92 line 6, Table 13. Maximum Radionuclide Concentrations in Lower Watts Bar Reservoir Sediment: Table 13 indicates that Strontium-89 was detected at 2.30 pCi/g in Lower Watts Bar Reservoir surface sediment. Strontium-89 is a short-lived fission product with a half-life of only 2.1 days; consequently, it seems unlikely the radionuclide would have originated from historical wastes. Since a recent nuclear reaction would be required to produce the isotope, is it reasonable to assume the contaminant	Your comment is noted. We agree that because Strontium 89 has a short half-life, this reported concentration of 2.30 picocuries per gram (pCi/g) in Table 13 could either be a misidentification or the radionuclide was released from the High Flux Isotope Reactor (HFIR) at the Oak Ridge National Laboratory.

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	originated at the High Flux Isotope Reactor or is the result due to laboratory error?	
66	The report should acknowledge that White Oak Creek and its discharges affect Roane County, not Anderson County. The title of the report is misleading in this case.	Thank you for the clarification. The X-10 site and White Oak Creek are located in Roane County, not Anderson County, and this change has been made to the title of the final PHA. It is important to note, however, that the study area for this public health assessment (see Figure 11 of the final PHA) consists of the area along the Clinch River from the Melton Hill Dam to the Watts Bar Dam. This not only includes Roane County, but also Meigs and Rhea Counties. ATSDR evaluated these areas in the final PHA because they are potentially impacted by X-10 radionuclide releases to White Oak Creek via the Clinch River and the Lower Watts Bar Reservoir. Please see Section II.E. Demographics in the final PHA for a description of the communities included within this study area.
67	It should be more clearly stated that this Public Health Assessment (PHA) is for off-site downstream residents exposed to radioactive elements and not for anyone working in the waste disposal areas. Other PHAs for this geographic scope should be cited, summarized, and referenced.	Your comment is noted. Under ATSDR's Evaluation of Exposure to Radionuclide Releases From X-10 in Section I. Summary of the final PHA, the following was added to the end of the first paragraph: "Please note that this document only evaluates **off-site exposures** to White Oak Creek radionuclide releases for downstream residents and others who use or who live along these waterways. It does not evaluate any exposures potentially occurring on site at the reservation, including exposures to workers and other individuals who may contact contaminants while at the ORR." Please note further that ATSDR does not prepare any public health assessments to evaluate on-site worker exposures. Other agencies are responsible for evaluating worker exposures that occur on site. ATSDR scientists have also conducted or are currently conducting public health assessments on: Y-12 uranium releases, off-site groundwater, Toxic Substances Control Act (TSCA) Incinerator releases, Y-12 mercury releases, X-10 iodine 131 releases, K-25 uranium and fluoride releases, PCB releases from X-10, Y-12, and K-25, and a current screening (1990 to 2003) of environmental data. For copies of these public health assessments, please contact ATSDR's Information Center toll-free at 1-888-422-8737.
Groundwater		
68	Page 11, Figure 3. Location of X-10 in Relation to Bethel Valley and Melton Valley. Display Bethel Valley and Melton Valley watersheds with depiction of existing groundwater plumes of contamination. Include the names of the underlying aquifers and their directional flow. Display the potential number of consumers that may be using these contaminated aquifers as a drinking water source.	In this public health assessment, ATSDR evaluated radioactive contaminant data for White Oak Creek releases that enter the Clinch River and travel downstream to the Lower Watts Bar Reservoir. To be clear, this public health assessment only evaluated X-10 radionuclides in White Oak Creek after the surface water was released off site. We recognize that oftentimes contaminants released into surface water may originate from contaminated groundwater, including on-site seeps and other sources of groundwater contamination. These potential exposures to off-site groundwater associated with the Oak Ridge

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	Page 17, Line 23. Add a statement that this means of disposal was entirely unprotective of the groundwater below these pits because of the very porous nature of the geology of this region. This region is nearly entirely very porous karst limestone. Contaminants released onto it leak through it like a sieve. The true extent of groundwater contamination from these unlined earthen pits is well know to ATSDR, EPA, TDH, TDEC, and DOE, but it has yet to be revealed by any of these 'public health' and/or 'regulatory' agencies. This passage will be useful in identifying the Primary Responsible Parties (PEPS) under CERCLA that will be responsible for paying for the cleanup of sediments if the Clinch River is ever dredged and cleaned up, just like has already been done with the Hudson River in New York. Page 18, Figure 7. Location of Solid Waste Storage Areas (SWSAs) at the X-10 Site. Show the contaminate plumes under these sites that are known to ATSDR, EPA, TDEC, TDH, and DOE. Show the directional flow of these contaminant plumes wit their directional flow and the aquifers that they have already reached as well as those others at risk. Show the potential numbers of people consuming water from these affected aquifers that these contaminant plumes drain into, both now and in the future. Page 19, Line 8. 'Hydrofacture technology' has most probably irrevocably contaminated deep groundwater beneath the facility where it occurred. Which aquifers have been contaminated by this technology at Oak Ridge National Laboratory (ORNL)? What is the latitude and longitude of all injection sites on the DOE ORR where these injections were made? This information will be necessary so that environmental advocacy groups, institutions of higher learning, and other stakeholders can utilize desktop Geographical Information Systems (GIS) to further analyze where these contaminants have migrated. These analyses will allow stakeholders to determine, on their own, the true extent of groundwater contamination from these unlined earthen pits. Is the true nature and extent of groundwater contamination from these unlined earthen pits known to ATSDR, EPA, TDH, TDEC, and DOE? Have federal and state public health and regulatory agencies withheld this information from stakeholders? Page 19, Line 11. The public also has a fundamental Right-to-Know right to this information concerning the nature and extent of this actual deep	Reservation, however, are addressed in another public health assessment titled *Evaluation of Potential Exposures to Contaminated Off-site Groundwater From the Oak Ridge Reservation (USDOE)*. This assessment addresses all of the issues presented by the commenter including plumes, contaminants flowing from groundwater, the underlying aquifers, and the other questions posed as well. Copies of this and other ATSDR documents are available from the ATSDR Information Center. You may call the center toll-free at 1-888-422-8737 or view the groundwater document online at http://www.atsdr.cdc.gov/HAC/PHA/region_4.html#groundwater. In addition, remedial actions are underway at the Oak Ridge Reservation and are proceeding according to the requirements of the Comprehensive Environmental, Response, Compensation, and Liability Act of 1980 (CERCLA). Completed and ongoing actions, including those associated with on-site groundwater contamination, are published annually in a remediation effectiveness report (RER). The RER is available at the DOE Information Center located at 475 Oak Ridge Turnpike, Oak Ridge, Tennessee (telephone number: 1-865-241-4780).

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	groundwater contamination and the potential numbers of consumers of these waters. Page 22, Line 22. Include a diagram of the extent of this watershed within DOE ORR. Include a depiction of the affected aquifers from the contaminant plumes beneath these tracts of land. Include the prospective numbers of populations that have in the past or will most probably in the future use these potentially contaminated aquifers for drinking water. Page 22, Line 29. Provide a detailed map of these five watersheds. Annotate this detailed map with their respective receiving aquifer(s) and the numbers of people who are either current or future consumers of these waters. Page 25. Figure 9. Map of the Major Remedial Activities in Bethel Valley. Several three dimensional depictions of affected groundwater aquifers and contaminant plumes have been developed by DOE and should be added to this PHA as companion figures to Figure 9. If ATSDR has trouble locating these, either check with several stakeholders that know of their whereabouts. Alternatively, and probably faster, check with the EPA Southeastern Regional Office in Atlanta, TDH, or TDEC. All of the above agencies already have these maps of contaminant plumes beneath this portion of DOE ORR. To date, these 'public health' and 'regulatory' agencies have simply withheld this critical information from the other stakeholders. Are there still contaminated groundwater plumes left in place below these 'grouted' tanks? If so, what is the nature and extent of the contamination of groundwater at these location, especially the radionuclides involved? Which specific radionuclides have been identified in these plumes? Which aquifers do they drain to? How many current and future users of these aquifers have been identified? Page 26, Line 25. Are there still contaminated plumes left in place below these 'grouted' tanks? If so, what are the specific radionuclides in these respective plumes? Which aquifers do these plumes drain into? What are the numbers of people either current or future consumers of water from these aquifers? These are critical answers for ATSDR to formulate responses to because on Page 27, line 25 ATSDR cites a DOE document	

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	(US DOE 2002b) as follows: "As a result, the waste sites in the Melton Valley Watershed…" are the primary contributors to off-site spread of contaminants" from the ORR. The citizens of Oak Ridge and all of its downstream (and down-aquifer) consumers of these waters are not reassured by ATSDR's seemingly superficial treatment of these critical exposure issues. Page 35, Line 19. Since ATSDR cites the interception of "downgradient contaminated groundwater:" Which specific radionuclides are contaminating the groundwater? What is the approximate curie load of each respective radionuclide? Which aquifer(s) are receiving this "downgradient contaminated groundwater? What are the numbers of current and future users of this contaminated groundwater? (*Comment received on the initial release PHA dated December 2003.)*	
69	Appendix A. ATSDR Glossary of Environmental Health Terms, Page A-1, Line 38. Down-aquifer stakeholders note that 'aquifer' is absent from this glossary. This is unfortunate because this PHA discusses groundwater injection of radioactive wastes at WOC, which of course has contaminated WOC's underlying groundwater. Groundwater leads to an AQUIFER. Stakeholders, many quite distant from WOC, may be drawing water from a contaminated aquifer. It would be helpful if aquifer were to be included in this glossary. (*Comment received on the initial release PHA dated December 2003.)*	This term is defined in ATSDR's PHA titled *Evaluation of Potential Exposures to Contaminated Off-site Groundwater From the Oak Ridge Reservation (USDOE)* available online at http://www.atsdr.cdc.gov/HAC/PHA/region_4.html#groundwater. Copies of this and other ATSDR documents are also available from the ATSDR Information Center. You may call the center toll-free at 1-888-422-8737.
Concerns of Conflicts of Interest		
70	Page 125, Line 25. ATSDR is not fulfilling its public health mandate because of an obvious conflict of interest with its funding from DOE. This PHA should be immediately redrafted using the many years of fish sampling data in the OREIS database. This robust data set dates from 1985. Importantly, next time use EPA standard CERCLA guidance and its risk-based PRGs for radioactive contaminants. Page 127, Line 6. Simply put, stakeholders believe that ATSDR is betraying the public health trust of the citizens of East Tennessee. DOE accepts DOE funding to perform DOE's "health studies." ATSDR and DOE both know the true extent of which radioactive contaminants that downwind, downstream, and down-aquifer stakeholders are being	In 1980 Congress created ATSDR to implement the health-related sections of laws protecting the public from hazardous wastes. ATSDR is a public health agency within the U.S. Department of Health and Human Services (HHS), and the lead agency for implementing the health-related provisions of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), referred to as Superfund. Since the 1986 Superfund Amendments and Reauthorization Act (SARA), ATSDR has been required by law to conduct public health assessments at each site on the U.S. Environmental Protection Agency's (EPA) National Priorities List. The investigation and the clean up of these sites is the responsibility of EPA and the individual states. As a potentially responsible party (PRP), the U.S. Department of Energy (DOE) provides funding to HHS for its Worker and Public Health Activities Program. The goal of this

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	exposed to. The risk estimates of these known exposure are being handled in a schizophrenic fashion: low-balling the estimates for the public and other "unsanitized" and probably higher estimates for DOE's epidemiological archives. (*Comments received on the initial release PHA dated December 2003.)*	program is to improve understanding of the effects on workers and people living in communities surrounding DOE facilities from exposures to ionizing radiation and other hazardous materials used in DOE activities. Under a memorandum of understanding (MOU) between DOE and HHS, three agencies within HHS will independently perform public health activities—ATSDR, the National Institute for Occupational Safety and Health (NIOSH), and the National Center for Environmental Health (NCEH). NIOSH performs epidemiological studies of DOE workers and NCEH conducts community-based epidemiologic studies and historical dose reconstruction projects. ATSDR conducts studies to determine if environmental contaminants could have caused past, present, and future health effects for off-site communities near DOE Superfund sites. As the lead public health agency responsible for implementing the health-related provisions of Superfund, ATSDR is charged with assessing health hazards at specific hazardous waste sites, helping to prevent or reduce exposure and the illnesses that result, and increasing knowledge and understanding of the health effects that may result from exposure to hazardous substances. As the PRP, DOE is required to fund cleanup and public health investigations, such as the ATSDR PHAs, for the Oak Ridge Reservation. The DOE funding is outlined in the MOU between HHS and DOE (see http://www.eh.doe.gov/health/documents/mou.pdf). This MOU also addresses ATSDR's public health responsibilities around DOE sites including public health assessments, health studies, health surveillance, and exposure registries. Implementing this MOU requires significant interaction with communities living in proximity to DOE sites. This charter is in response to requests from community representatives surrounding DOE sites to provide consensus advice and recommendations on community concerns to CDC's and ATSDR's activities related to the sites. As a federal advisory agency, ATSDR conducts independent and objective public health evaluations. We make our decisions based on available data and current science—the source of our funding does not bias our evaluations, our assessment of data, or our scientific conclusions. In public health assessments for the ORR, ATSDR uses available data not only from DOE, but from other government agencies such as the Tennessee Valley Authority (TVA). ATSDR conducts its own evaluations of data and makes its own conclusions; it does not depend on previous conclusions and findings from DOE, other governmental agencies (federal, state, or local) or private entities. In addition, to ensure accuracy of this PHA's data and conclusions the White Oak Creek Radionuclide Releases document underwent several phases of review before its final release, including an internal ATSDR review, a data validation review by other agencies (i.e., DOE, EPA, and the Tennessee Department of Environment and Conservation

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		[TDEC]), an Oak Ridge Reservation Health Effects Subcommittee (ORRHES) review, an independent external peer review, and a public comment review. During the agency's internal review process, individuals within the agency who have the proper background (e.g., toxicology and health physics) carefully reviewed the document for technical content and other aspects. After reviewing comments received from other agencies during the data validation review, ATSDR made changes to the document as appropriate. ORRHES members consisted of individuals representing different expertise, backgrounds, geographic areas, and interests from the communities surrounding the Oak Ridge Reservation. ORRHES had technical experts in toxicology, health physics, medicine, geology, and other disciplines as well. ORRHES members carefully discussed all suggested editorial and technical changes and then submitted recommendations to ATSDR for changing the document. Through its external peer review process, ATSDR's Office of Science had three scientific experts review this public health assessment (see Appendix H for the peer reviewer comments and ATSDR's responses). The agency's peer review process allows an external, thorough evaluation of this PHA by experts in the field that this assessment covers—health physics. During the external review process, individuals (not employed by ATSDR or the CDC) independently reviewed this document and provided their unbiased, scientific opinions of it. ATSDR also presented the data and information used in this public health assessment several times at public meetings, including work group and ORRHES meetings. In addition, during the PHA public comment period, any member of the public can provide comments to ATSDR. The public comments are presented and responded to within this appendix. Regarding EPA CERCLA guidance, please see the response to comment 44 in this appendix describing the differences between risk assessments and public health assessments. HHS and DOE's Office of Health Studies collaboratively develop an Agenda for HHS Public Health Activities at DOE Sites, including the Oak Ridge Reservation. The most recent version of the agenda is available online at http://www.eh.doe.gov/health/documents/Agenda2003-08.pdf. The agenda includes HHS committees' proposals for health studies and public health activities for DOE sites. In addition, for some sites such as the Oak Ridge Reservation, the agenda includes feedback provided during open public meetings. The agenda identifies issues needing attention at each DOE site and outlines proposed future public health activities. A draft agenda is released for public comment and the input received is reflected in the final agenda. In 2001, ATSDR scientists conducted a review and analysis of the Phase I and Phase II screening evaluation of the Tennessee Department of Health's (TDOH) Oak Ridge Health Studies, available at http://www2.state.tn.us/health/CEDS/OakRidge/ORidge.html to identify

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		contaminants that require further public health evaluation. In the Phase I and Phase II screening evaluation, TDOH conducted extensive reviews of available information and conducted qualitative and quantitative analyses of past (1944–1990) releases and off-site exposures to hazardous substances from the entire Oak Ridge Reservation. Having reviewed and analyzed Phase I and Phase II screening evaluations, ATSDR scientists are conducting nine public health assessments on: Y-12 uranium releases, White Oak Creek radionuclide releases, off-site groundwater, Toxic Substances Control Act (TSCA) Incinerator releases, Y-12 mercury releases, X-10 iodine 131 releases, K-25 uranium and fluoride releases, PCB releases from X-10, Y-12, and K-25, and a current screening (1990 to 2003) of environmental data. For copies of these public health assessments, please contact ATSDR's Information Center toll-free at 1-888-422-8737.
71	With respect to ATSDR work at Oak Ridge, the local situation has become quite serious. There appears to be willful administrative intent to ignore both internal and outside comments and criticism. Members of the local ORR Health Effects Subcommittee have been allowed to influence discussions and voting procedures who have known organizational and economic conflicts of interest. Yet, few members of the ORRHES have the required expertise in dose reconstruction, risk evaluation, and quantitative uncertainty analysis in order to effectively oversee the technical work of ATSDR and properly interpret past work in dose reconstruction conducted at Oak Ridge. Those who have raised critical concerns and comments have been summarily dismissed.	In 1999, ATSDR established the Oak Ridge Reservation Health Effects Subcommittee (ORRHES) under the laws, rules, and guidelines of the Federal Advisory Committee Act (FACA) to provide ATSDR with advice and recommendations related to public health activities and research at the ORR. FACA requires all committee members to be "fairly balanced in terms of the points of view represented and the functions to be performed." As a result, the selected subcommittee members consisted of individuals representing different expertise, backgrounds, geographic areas, and interests. ORRHES had technical experts in toxicology, health physics, medicine, geology, and other disciplines as well. Regarding the statement concerning ORRHES members having known conflicts of interest, every ORRHES member was considered a special government employee. Under this role, each subcommittee member had to comply with the Standards of Ethical Conduct for Employees of the Executive Branch, Conflict of Interest Statues, the U.S. Department of Health and Human Services (HHS) Standards of Conduct, and regulations governing confidentiality and procurement integrity. Under these guidelines, ORRHES members had to be impartial in their roles and responsibilities while serving on the subcommittee. All ORRHES meetings followed the operation of FACA. ORRHES and work group meetings were open to the public, and ATSDR considered feedback and opinions from public members as well as from ORRHES members. The subcommittee voted to use Robert's Rules of Order, and operated its meetings in accordance with these guidelines. No individual ORRHES member was able to influence or change these established rules governing the subcommittee and its operations. Every change and recommendation in ORRHES was not accepted unless it was approved by a two-thirds majority vote within the subcommittee. Though ATSDR gave significant weight to the ORRHES's consensus recommendations when making its decisions, ATSDR retained independent decision-making authority for public health activities. Over the past 5 years, more than 25 ORRHES

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		and 135 work group meetings were held. During this time, ATSDR staff members gave numerous technical presentations on public health assessments and related issues to ORRHES and work groups and technical experts in various disciplines presented to ORRHES as well. For information on meeting agendas and meeting minutes, please visit the ORRHES Web site at http://www.atsdr.cdc.gov/HAC/oakridge/. In addition, all nine public health assessments undergo several phases of review, including internal ATSDR review, a data validation review by other agencies (i.e., DOE, EPA, and TDEC), an ORRHES review, an independent peer review, and a public comment review (see the response to comment 70 for more details). Thus, even though participants at ORRHES and work group meetings provided expertise in these areas mentioned by the commenter (i.e., dose reconstruction, risk evaluation, and quantitative uncertainty analysis), these are not the only individuals reviewing this document. It undergoes several rounds of review by experts in these fields of study and other areas of interest for this document (e.g., health physics). All comments received during the public comment period and review are responded to and included within this appendix in the final PHA. In addition, comments received by the peer reviewers and ATSDR's responses are included in Appendix H of the final PHA.
Additional Comments		
72	Page 5, line 4: ATSDR needs to amplify its very limited bibliography to, at a minimum, include the website for DOE's OREIS database and users guide. (*Comment received on the initial release PHA dated December 2003.)*	The Oak Ridge Environmental Information System (OREIS) has been added to the reference list. The references presented in Section XII of this PHA include the resources used to prepare this final PHA. Though the documents such as reports, the OREIS users guide, and other available information about the ORR are numerous, only resources used to prepare the report are presented in the reference list.
73	Page 7, Line 24. There was another facility near this location as well, the S-50 plant. We believe that it was a nuclear reactor used to make an atomic aircraft. The project was subsequently abandoned. This should be included here because it is on the map in Figure 1, and its contaminants possibly are still in place, especially Co-60, Sr-90, and Cs-137. (*Comment received on the initial release PHA dated December 2003.)*	ATSDR scientists conducted a review and analysis of the Phase I and Phase II screening evaluation of the Tennessee Department of Health's (TDOH) Oak Ridge Health Studies to identify contaminants that require further public health evaluation. In the Phase I and Phase II screening evaluation, TDOH conducted extensive reviews of available information and conducted qualitative and quantitative analyses of past (1944–1990) releases and off-site exposures to hazardous substances from the entire Oak Ridge Reservation. Using this review, ATSDR scientists are conducting nine public health assessments on ■ Y-12 uranium releases, ■ White Oak Creek radionuclide releases, ■ off-site groundwater, ■ Toxic Substances Control Act (TSCA) Incinerator releases, ■ Y-12 mercury releases,

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		■ X-10 iodine 131 releases, ■ K-25 uranium and fluoride releases, ■ PCB releases from X-10, Y-12, and K-25, and ■ a current screening (1990 to 2003) of environmental data. For copies of these public health assessments, please contact ATSDR's Information Center toll-free at 1-888-422-8737. As noted, this includes a public health assessment on uranium and fluoride releases from the K-25 site, which comprises the former S-50 plant. For more information on the screening evaluation, please see the Phase I Dose Reconstruction Feasibility Study and Task 7 Screening Level Evaluation of Additional Potential Materials of Concern briefs in Appendix D of the final PHA. For additional information on how specific contaminants were identified as requiring further evaluation based on screening evaluations that evaluated past exposures, please see the TDOH's Oak Ridge Health Studies at http://www2.state.tn.us/health/CEDS/OakRidge/ORidge.html. The S-50 site contained approximately 37 acres and was located next to the K-25 Power House along the Clinch River. This site operated for less than 1 year; however, and is now part of the K-25 site. As all of the facility's buildings were destroyed and buried in 1946, no physical evidence of S-50 at the K-25 site remains. Construction of the former S-50 liquid thermal diffusion plant began on June 6, 1944, and it was fully operational by October 1944. The purpose of the plant was to assess the financial and scientific feasibility of separating uranium 235 (U 235) from uranium 238 (U 238) through liquid thermal diffusion. Because of constant equipment malfunctions and releases to the Clinch River and to the air, the plant was closed in September 1945. The only documented process at the S-50 site was liquid thermal diffusion enrichment between 1944 and 1945.
74	Page 12, Figure 4. Location of White Oak Creek (WOC) and the Relationship Between X-10, White Oak Lake, White Oak Dam, the Clinch River, and the Watts Bar Reservoir. In the legend, the direction of primary river flow is indicated. No information indicates the existence of the well-known 'back flow' of the river caused by hydraulic changes in the directional flow due to 'draw downs' in the TVA system, power generation events at Watts Bar, and other events. This is important because the water supply for towns like Kingston is, in fact, water intakes that do draw water from the Clinch River from water that occasionally FLOWS BACKWARDS. This means that even though Kingston's water intake appears to be upstream from the contaminated confluence of tributaries from K-25 Kingston's water intake is actually downstream during frequent river backflow events. This unfortunate set of circumstances means that the	Kingston maintains public water supplies in the vicinity of the Oak Ridge Reservation (see Figure 13). The Kingston water supply has two water intakes, but ORR contaminants would potentially affect only one of the intakes located upstream on the Tennessee River in Watts Bar Lake at Tennessee River Mile (TRM) 568.4. Spring City obtains its water from an intake on the Piney River branch of Watts Bar Lake. The city of Rockwood receives its water from an intake on the King Creek branch of Watts Bar Lake, located at TRM 553. These three intakes could potentially be affected, however, only during reverse flow conditions. Under the Safe Drinking Water Act, the U.S. Environmental Protection Agency (EPA) has set health-based standards for substances in drinking water and specified treatments for providing safe drinking water since 1974 (USEPA 1999). In 1977, EPA gave the state of Tennessee authority to operate its own Public Water System Supervision Program under the Tennessee Safe Drinking Water Act. Through this program, the Tennessee Department of Environment and Conservation's (TDEC) Division of Water Supply regulates drinking

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	entire population of towns like Kingston are drawing water from the contaminated confluence of K-25's tributary to the Clinch. Local citizens are particularly aware of this [backwards flow] during periodic fish kills near Kingston. Anyone can watch the dead fish float from the K-25 confluence right up to Kingston's water intake for the city. Some citizens have documented these events with photographs, in case ATSDR did not realize that the people of Kingston are, in fact exposed via drinking water because of the backflow events described above. The citizens of communities like Kingston, Spring City, and many others do not believe that ATSDR had done its homework in contemplating the consequences of the backflow events of the Clinch in determining possible routes of exposure by drinking water. The citizens of communities along the Clinch again do not believe that ATSDR has done an adequate job of determining where the radioactive fish actually are because of Agency's simplistic assumption that fish contaminated by radioactive sediments at the confluence of tributaries draining from waste sites like WOC and K-25 simply stay put. Fish don't stay put. Fish swim around and do leave the area. Some species travel far downstream and upstream. Bottom feeders, which are most probably contaminated via consumption of sediment can be flushed out during reservoir drawdowns and/or power generation events. This means that radioactively contaminated fish are not 'contained' by Watts Bar, but most probably have already either migrated upstream or have been 'flushed downstream.' (*Comment received on the initial release PHA dated December 2003.)*	water at all public water systems. As a requirement of this program, all public water systems in Tennessee individually monitor their water supply for EPA-regulated contaminants and report their monitoring results to TDEC. The public water supplies for Kingston, Spring City, Rockwood, and other supplies in Tennessee are monitored for substances that include 15 inorganic contaminants, 51 synthetic and volatile organic contaminants, and 4 radionuclides. See http://www.epa.gov/safewater/pws/pdfs/qrg_smonitoringframework.pdf for EPA's monitoring schedules for each contaminant. On a quarterly basis, TDEC submits the individual water supply data to EPA's Safe Drinking Water Information System (SDWIS). According to EPA's SDWIS, the Kingston, Spring City, and Rockwood public water supply systems have not had any significant violations. To access information related to these and other public water supplies, go to EPA's Local Drinking Water Information Web Site at http://www.epa.gov/safewater/dwinfo.htm. In addition, in 1996 TDEC's DOE Oversight Division began to participate in EPA's Environmental Radiation Ambient Monitoring System (ERAMS). As part of the Oak Ridge ERAMS program, TDEC collects samples from five facilities on the ORR and in its vicinity. Under the Oak Ridge ERAMS, TDEC collects finished drinking water samples from the Kingston Water Treatment Plant on a quarterly basis and then submits the samples to EPA for radiological analyses. The contaminants sampled at the Kingston Water Treatment Plant are presented in Section II.F.3. of the final PHA. TDEC has also conducted filter backwash sludge sampling at Spring City because radioactive contaminants from the ORR could potentially move downstream into community drinking water supplies. TDEC analyzed Spring City samples for gross alpha, gross beta, and gross gamma emissions. To inquire about your drinking water, please call TDEC's Environmental Assistance Center in Knoxville, Tennessee at 1-865-594-6035 or call EPA's Safe Drinking Water Hotline at 1-800-426-4791. More details are also available at EPA's Safe Drinking Water Web site at http://www.epa.gov/safewater/. For past exposure, Task 4 of the Tennessee Department of Health's Reports of the Oak Ridge Dose Reconstruction (Task 4 report) (presented in Section III.B.2. Past Exposure of the final PHA) estimated the amount of radiological contamination resulting from Clinch River backflow that could have entered the Kingston water intake, as well as the effect of water treatment on the drinking water. Nonetheless, under drinking water ingestion in Section III.B.2. of the final PHA, the following was added to the discussion of how the Task 4 team evaluated drinking water for the city of Kingston: "Water from the Clinch River can travel up the Tennessee River when the Clinch River's flow is greater than the Tennessee River's flow. As a result of this backflow, the city of Kingston could receive Clinch River water. The Task 4 team estimated 1) the amount of radiological contamination resulting from Clinch River backflow possibly entering the Kingston water intake and 2) the effect of

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		water treatment on the drinking water."
	Page 38, line 25: Kingston public water supply is located about one mile up the Tennessee River from the mouth of the Clinch, which is not in the study area; however, at times Clinch River Water can enter the intake on the Tennessee River.	Although during backflow Clinch River water can enter these intakes, this water is treated before it is distributed to Kingston city drinking water consumers. Further, the past estimated whole-body lifetime (over 70 years) dose from ingestion of city of Kingston drinking water was 1.4 mrem, which is more than 3,500 times less than ATSDR's radiogenic cancer comparison value of 5,000 mrem over 70 years. Because of strict regulatory guidelines and water treatment prior to distribution, potential current and future exposures to harmful levels of radionuclides in the home from municipal water use are expected to be limited—monitoring data indicate that drinking water has met safe drinking water standards for radionuclides. Regarding the "fish kills" mentioned by the commenter, it is important to note that there has never been enough (at least 2,000 rad) acute radioactive pollution in the Clinch River or White Oak Creek to kill fish. The highest radiation doses for past exposures to the Clinch River were associated with consuming fish collected from the Clinch River near Jones Island. For fish ingestion near Jones Island, ATSDR's derived annual whole-body dose was less than 3.4 mrem/year—nearly 30 times less than the 100 mrem/year dose limit recommended for the public by the International Commission on Radiological Protection (ICRP), the U.S. Nuclear Regulatory Commission (NRC), and the National Council on Radiation Protection and Measurements (NCRP). The lifetime whole-body dose from ingesting fish near Jones Island was 238.6 mrem over 70 years, which is more than 20 times less than ATSDR's radiogenic cancer comparison value of 5,000 mrem over 70 years. Because even the worst-case scenario was not found to be a public health hazard, areas downstream of White Oak Creek—where X-10 radionuclide concentrations would be lower—would also not be expected to pose a hazard. Please note that the White Oak Creek study area, as shown in Figure 11 and discussed throughout the final PHA, consists of the area along the Clinch River and the Lower Watts Bar Reservoir from the Melton Hill Dam to the Watts Bar Dam. In the final PHA, please also see Figure 13 and Figure 14 for the location of the Kingston water intake included in this study area. Further, page 90 of the final PHA discusses how Clinch River water can enter the Kingston water intake.
75	Page 15, Line 12. What were the major components of these liquid wastes which were discharged into White Oak Creek (WOC)? According to the ORHASP Final Report, p. 40, releases of Cs-137, which contributed most to the risk, were highest in 1955 to 1959. WOC was drained in 1955 and the lake stayed low until 1960. This allowed the high creek flows	See Table 2 in the final PHA for the estimated discharges of radionuclides from White Oak Creek to the Clinch River as reported in the Clinch River/Poplar Creek remedial investigation/feasibility study (RI/FS) (http://www.osti.gov/bridge/servlets/purl/226399-5omhIT/webviewable/226399.pdf). The radionuclides expected to be of most concern are depicted in gray—cesium 137, ruthenium 106, strontium 90, and cobalt 60. Table 3 in the

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	accompanying heavy rains, especially in the winter and early spring of 1956, to scour the sediments in which radionuclides had accumulated. Releases during these years are believed to be responsible for the relative high concentrations of Cs-137 found in subsequent cores and samples from WOC below: the lake, the Clinch River, and lower Watts Bar. Additionally, because Cs-137 is in the same chemical periodic table family as Potassium (K), it, like K, Cs-137 in the environment is incorporated into the flesh of fish and other aquatic species. Were there also large releases of Sr-90 as well? ATSDR's Public Health Assessment (PHA) is apparently silent on this. Page 38 of the ORHASP Final Report indicates that the main radionuclides releases to WOC were: Cs-137, Ruthenium-106 (Ru-106), Co-60, and Sr-90. The releases of Sr-90 are particularly important to human health because, analogous to Cs-137 substituting for K, Sr-90 is likewise in the same chemical periodic table family as Calcium (Ca). Consequently, Sr-90 in the environmental will bioaccumulate into the bones of fish. Thereby, if fish are either stewed or made into patties the Sr-90 in the fish bone will end up in the bones of the people who consume them. (*Comment received on the initial release PHA dated December 2003.)*	final PHA presents a summary of the peak annual releases from White Oak Dam for the eight key radionuclides as reported in the Oak Ridge Dose Reconstruction Project Summary Report (available at http://www2.state.tn.us/health/CEDS/OakRidge/ProjSumm.pdf). In addition, see Section III.B.2. Past Exposure in the final PHA for a description of the screening evaluations conducted in the *Task 4 of the TDOH's Reports of the Oak Ridge Dose Reconstruction: Radionuclide Releases to the Clinch River from White Oak Creek on the Oak Ridge Reservation—an Assessment of Historical Quantities Released, Off-Site Radiation Doses, and Health Risks* (referred to as the "Task 4 report"). A brief on the Task 4 report is also available in Appendix D of the final PHA and the report can be viewed at http://www2.state.tn.us/health/CEDS/OakRidge/WOak1.pdf. There were also large releases of strontium 90 in addition to cesium 137 releases. This is mentioned throughout the PHA (see Sections II.C., III.B.2., and III.B.3) and past, current, and future potential exposures to this radionuclide are evaluated in this document. According to the RI/FS for the Clinch River/Poplar Creek, since 1944 the X-10 radionuclides disposed of in the largest quantities—either via on-site burial or liquid waste discharge to pits and trenches—are cesium 137, strontium 90, and unidentified beta emitters. Please note, however, that these are releases that occurred **on site**. ATSDR only evaluated radionuclides released into White Oak Creek that traveled off site into the Clinch River and the Lower Watts Bar Reservoir. Strontium 90 is chemically similar to calcium and tends to deposit in bone and blood-forming tissue (bone marrow). Accordingly, strontium 90 is referred to as a "bone seeker." For evaluating past exposures, ATSDR summarized the Task 4 organ doses for the bone, lower large intestine, red bone marrow, breast, and skin. The contaminants of concern, particularly strontium 90 and cesium 137, tend to concentrate in these organs. For current exposures at the Lower Watts Bar Reservoir, ATSDR evaluated fish sampled for cesium 137, cobalt 60, and strontium 90 and estimated whole-body doses resulting from potential exposure to these contaminants via fish consumption. For strontium 90, ATSDR assumed that the meal could include some bone. For current exposures for the Clinch River, ATSDR evaluated cesium 137, cobalt 60, strontium 90, yttrium 90, americium 241, and hydrogen 3 based on the Oak Ridge Environmental Information System (OREIS) fish data. ATSDR evaluated the critical organ for each radionuclide and estimated the radiation dose delivered to the whole body. These evaluations show that the level of potential radiological exposure from radioactive contaminants in Clinch River and Lower Watts Bar Reservoir fish do not represent a past, current, or future public health hazard. This evaluation is discussed in detail in Section III.B. Exposure Evaluation of the Clinch River and Lower Watts Bar Reservoir in the final PHA.

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		For information on fish advisories, please refer to the response to comment 9 in this appendix.
76	Page 22, line 18: "The building of a coffer cell dam to prevent the backflow of water from the Clinch River into White Oak Creek Embayment:" Prior to 1963 there was little backflow into White Oak Creek embayment except during floods on the Clinch River. However, in 1963 Melton Hill Dam was impounded and became a peaking unit which means that water from the dam was released during the morning and evening hours for a short period of time to meet the increased electrical demands. However, the amount released was about equivalent to the daily flow of the Clinch River at White Oak Creek. This large volume released from Melton Hill Dam would cause a backflow up White Oak Creek Embayment and would result in the scouring of sediment from the embayment. The large amount of Cesium-137 released in 1956 after the draining of White Oak Dam that had been covered by sedimentation was gradually uncovered by the backflow of water from Melton Hill Dam that was being transported into the Clinch River. This change in flow of water below Melton Hill Dam also changed the distribution of radionuclides released into the Clinch River. Whereas previously a more or less constant flow of water passed the mouth of White Oak Creek, afterwards (except during peaking operations) there was virtually no flow past the mouth of White Oak Creek. The outflow from White Oak Creek would often flow upstream in the Clinch River.	Thank you for your suggestions. We have similar text on pages 14, 17, and 25 of the final PHA, and incorporated some of these suggested changes into that text.
77	Page 28, Line 5. Regarding these eight 'experimental' plots – was this an actual DOE experiment, or actually a cheap-and-dirty disposal practice, similar to the common practice of drying municipal sewage on land? (*Comment received on the initial release PHA dated December 2003.)*	The referenced section is no longer within the main text, but in Appendix B of the final PHA. As discussed in the record of decision for the waste area grouping (WAG) 13 cesium plots (available at http://www.epa.gov/superfund/sites/rods/fulltext/r0493137.pdf), these plots are the result of an actual U.S. Department of Energy (DOE) experiment at the Oak Ridge National Laboratory (ORNL) to simulate conditions of a nuclear fallout. These plots are located on site and access is restricted. In this public health assessment, ATSDR evaluates exposures occurring off site only. In 1968, each of four 33-by-33-foot treatment plots were contaminated with 2.2 curies of cesium 137 via fusing the cesium with silica sand particles at high temperatures; four "control" plots were not contaminated. Cesium 137 was selected because it is a long-lived component of weapons fallout. The main purpose of the experiment was to evaluate the

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		long-term, low-dose effect of radiation to the environment, specifically to vegetation. The plots occupy an approximate 6-acre area and are enclosed by a perimeter fence. Sheet metal, extending 18 inches below and 24 inches above ground surface, enclosed each plot. Before the experiment, ORNL researchers suspected that the fused cesium particles would not migrate horizontally in any direction or more than 6 to 12 inches vertically. Soil samples collected at the site in 1987 indicated, however, that cesium had migrated horizontally in a northwest plume of several feet and vertically to depths of 3 to 4 feet. To prevent potential threats to public health and the environment, remedial actions were conducted and finished in July 1994. The main aspects of the interim action were: ■ excavating soil until contamination was reduced to permissible levels; ■ placing extracted soil into boxes made to store low-level radioactive waste; ■ moving the soil to the low-level waste silos at WAG 6; and ■ placing a porous liner, clean fill material, and a clean top layer of soil into each excavated plot. Since completion of the interim action, a fence containing many locked gates has enclosed WAG 13. Several signs are posted to notify people of on-site soil contamination and of restricted access to the site. In addition, the site is inspected on a quarterly basis.
78	Page 28, Line 27. What is meant by "uncontrolled?" It should intend that the contaminated sediments from WOC moved offsite to the Clinch River, onto Watts Bar, and to other downstream locations. Most probably, these contaminated sediments, and the bottom fish and other aquatic organisms that feed on them, have undoubtedly been flushed far and wide through the TVA system. The extent of this spread either through electrical power generation events or drawdowns in the series of TVA reservoirs has likely spread these sediments and the aquatic organisms that feed on them to at least Mocassin Bend in Chattanooga, TN if not to the TVA confluence at Paducah, KY. For ATSDR to simply postulate that the dam at Watts Bar contains the problem and the dredging these radioactive sediments is not an option is baseless. The citizens of Oak Ridge, Kingston, Spring City, and all other downstream communities along the hundreds of miles of the TVA system from Clinch River Mile 1 to the confluence of the Tennessee and Ohio Rivers are not buying it. All of these stakeholders insist that ATSDR start sampling sediments from at least Oak Ridge to at least the embayment at Mocassin	Please note that the referenced section is no longer within the main text, but in Appendix B of the final PHA. "Uncontrolled" refers to how surface sediments containing cesium 137 and other sediment-bound contaminants in the White Oak Creek Embayment can erode and be transported downstream to the Clinch River system. Daily releases of water from Melton Hill Dam and flood flows in White Oak Creek caused water to surge into and out of the White Oak Creek Embayment, resulting in the erosion of cesium 137 and other contaminant-containing sediments. In the early 1990s, however, a sediment retention structure was built at the mouth of White Oak Creek to retain the sediments in the lower White Oak Creek Embayment and lessen the off-site movement of the sediments to the Clinch River and the Watts Bar Reservoir. According to various studies, most of the sediment-associated contaminants released from the Oak Ridge Reservation collected in the Lower Watts Bar Reservoir. Therefore, concentrations of sediment-associated contaminants released from the reservation are significantly lower in reservoirs located downstream of Watts Bar Dam. Past studies have found that detected levels of contaminants released from the ORR into the Tennessee River system—below the Watts Bar Dam—are far below levels found to be hazards for human health in the Watts Bar Reservoir baseline risk assessment. If ATSDR believed that the

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	Bend in Chattanooga. Otherwise, ATSDR doesn't really know which sediments are affected downstream, who is actually exposed now, and who is likely to be exposed in the future from radioactive contamination of fish and other aquatic organisms all along the TVA system. (*Comment received on the initial release PHA dated December 2003.)*	sediments and fish were a public health issue, then we would recommend that additional sampling be conducted. The findings in this PHA, past studies on the Tennessee River system, and ongoing monitoring programs, however, show that additional sampling is unnecessary. The record of decision (ROD) for the Lower Watts Bar Reservoir (available at http://www.epa.gov/superfund/sites/rods/fulltext/r0495249.pdf), issued by the U.S. Department of Energy (DOE) and supported by the U.S. Environmental Protection Agency (EPA) and the Tennessee Department of Environment and Conservation (TDEC), determined that buried sediments remaining in place pose no health risk because of the absence of any exposure pathway for humans. In 1996, ATSDR conducted a health consultation on the Lower Watts Bar Reservoir that concurred with the ROD. ATSDR reviewed these findings in this public health assessment and we continue to support this conclusion. Based on our findings in this PHA, we concur with DOE, EPA, and TDEC that leaving deep sediments in place poses no public health hazard. According to the record of decision and ATSDR's evaluations, the only threat to human health was associated with the consumption of certain fish species due to PCB contamination—no health hazards were found to be associated with ORR-related radionuclide releases in Watts Bar Reservoir sediment (if left undisturbed), surface water, or biota. Please note: as shown in Figure 11 and discussed throughout the final PHA, the White Oak Creek study area consists of the area along the Clinch River and the Lower Watts Bar Reservoir from the Melton Hill Dam to the Watts Bar Dam.
79	Page 28, Line 28. What are the radiological measurements of this area, both before and after 'remediation?' If these areas have actually been 'remediated' to acceptable levels of public exposure, why is the hazard warning signage still in place? (*Comment received on the initial release PHA dated December 2003.)*	Please note that the referenced section is no longer within the main text, but in Appendix B of the final PHA. This section of the document refers to the White Oak Creek Embayment located on site at the reservation where access is restricted; our public health assessment evaluates radionuclides that traveled off site. Sediment samples collected in summer 1990 from the lower portion of the White Oak Creek Embayment showed the presence of cesium 137 and cobalt 60 in near-surface sediment (upper 2 to 4 inches). Levels of cesium 137 were higher than expected—a finding based on sediment samples collected at the embayment in 1979 and 1984 that showed contamination only in deeper sediment (about 1 to 2 feet below surface). These results in 1990 caused concern: White Oak Creek Embayment sediments were uncontrolled at that time, meaning surface sediments could erode and travel downstream to the Clinch River. As explained in Appendix B of the final PHA, in the early 1990s a removal action was conducted at the embayment. This action consisted of building a sediment retention structure at the mouth of White Oak Creek in the early 1990s to prevent contaminants in

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		surface sediments from traveling from the White Oak Creek Embayment to the Clinch River system. Thus, this time-critical removal action resulted in retaining the sediments in the lower embayment and reducing off-site movement of the sediments to the Watts Bar Reservoir and the Clinch River. In 2001, after about 10 years of data collection and monitoring, a remediation effectiveness report suggested discontinuing regular water level monitoring at the embayment because data showed that the sediment retention structure prevented scouring of the embayment and sustained sediment water coverage. Completed and ongoing actions at the reservation, including those associated with the White Oak Creek Embayment, are published annually in a remediation effectiveness report (RER). The RER is available at the DOE Information Center located at 475 Oak Ridge Turnpike, Oak Ridge, Tennessee (telephone number: 1-865-241-4780).
80	Page 35, Line 24. Regarding the "contaminated sediment from the high flux isotope reactor (HFIR) ponds." Which specific radionuclides are related to this process? Which are known to be in this 'contaminated sediment?' Are these contaminated sediments still in place or have they been removed? If they have been removed, where did they go? Are they still at DOE ORR? Have they been taken to an offsite location? If they are still in the bottom of the HIFR ponds are they continuing to leach into WOC? ATSDR needs to be more forthcoming about the nature, extent, and actual location of these contaminated sediments and whether or not they still pose an ongoing public health hazard. What is the actual state of affairs here? Are these contaminants still there leaking into the groundwater? Are the citizens of Oak Ridge and downstream communities still at risk from leachate from the HFIR ponds into WOC? Which is ostensibly ATSDR's main purpose in producing this PHA? (*Comment received on the initial release PHA dated December 2003.)*	Please note that the referenced section is no longer within the main text, but in Appendix B of the final PHA. In addition, it is important to understand that the high flux isotope reactor ponds (HFIR) are located on site at the reservation; this public health assessment evaluates radionuclides released to White Oak Creek that traveled off site into the Clinch River and the Lower Watts Bar Reservoir. Nonetheless, we would like to provide responses to your questions below. The HFIR at the Oak Ridge National Laboratory (ORNL) has operated since 1966 to produce radioisotopes for medical, academic, and industrial purposes, as well as perform other scientific functions (e.g., irradiation tests and experiments). The HFIR uses highly enriched uranium 235 as fuel for this light water-cooled reactor. Radioisotopes produced at the HFIR include einsteinium 253, iridium 192, platinum 195, berkelium 249, lutetium 177, cobalt 60, nickel 63, californium 252, holmium 166, tin 177, fermium 257, tungsten 188, rhenium 186, and others. From the 1960s until 1986 radioactive contaminants related to processes at the HFIR were placed into four ponds, also referred to as surface water impoundments or subbasins. These ponds, located south of the HFIR building, are inactive and lie along Melton Branch. According to the Melton Valley remedial investigation, no data are available on radionuclides in HFIR pond sediment. Sediment data show, however, the presence of cobalt 60 and cesium 137 in contaminated sediment along Melton Branch downstream of the HFIR facility. Soil data for the ponds show the presence of cesium 137, cobalt 60, strontium 90, and thorium 288. Primarily, cesium 137 and cobalt 60 are contaminants of concern for the area. But according to the ORNL's risk assessment information system (available at http://risk.lsd.ornl.gov/maps/x-10/x10_relsites.shtml), these disposal ponds have not released radionuclides.

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		Because of the short half-life of cobalt 60 (5.3 years), releases of this contaminant from the HFIR ponds has decreased to the point of no longer being detectable in surface water near the ponds. A surface water monitoring location on Melton Branch is just downstream of the HFIR drainage areas. In 1993 and 1994, these areas only contributed <1% of tritium and <0.2% of strontium 90 releases into White Oak Dam, but reportedly contributed 17.2% of cesium 137 to White Oak Dam based on remedial investigation data for waste area grouping (WAG) 5 (though data at this monitoring station usually show nondetects for cesium 137). Excavation activities began in summer 2004 to remove contaminated sediment at the four HFIR ponds—7905, 7906, 7907, and 7908. The HFIR ponds, built for storing wastewater from the HFIR and for providing further settling before treatment or discharge to surface waters, are clay-lined, earth-bermed, and open. The ponds are located in Melton Valley, a restricted area of the reservation remaining under DOE control. Remediation goals were established based on anticipated future use of the land. No residents have access to this land and future use is expected to remain industrial. The waste is being disposed of on site at the Oak Ridge Environmental Management Waste Management Facility (EMWMF) located in Bear Creek Valley near the Y-12 Plant. In addition, contaminated soils, liquids, and sludges associated with the ponds will be removed. According to the Melton Valley remedial investigation, no groundwater contaminants of concern associated with the HFIR ponds have been identified. For information on ATSDR's evaluation of off-site exposure to groundwater related to the ORR, please refer to the PHA titled *Evaluation of Potential Exposures to Contaminated Off-site Groundwater From the Oak Ridge Reservation (USDOE)* (available at http://www.atsdr.cdc.gov/HAC/PHA/region_4.html#groundwater). Copies of this and other ATSDR documents are available from the ATSDR Information Center. The center can be reached toll-free at 1-888-422-8737. Section III. Evaluation of Environmental Contamination and Potential Exposure Pathways in the final PHA details ATSDR's analysis of past, current, and future exposures to White Oak Creek radionuclide releases via fish and other biota. Section IV. Public Health Implications details the weight-of-evidence approach ATSDR used to compare estimated radiation doses to situations associated with disease and injury to determine whether harmful health effects could be possible and observable. Based on our evaluation, ATSDR concluded that past, current, and future exposures to radionuclides released from White Oak Creek to the Clinch River and the Lower Watts Bar Reservoir are not a public health hazard for people who lived along or used these waterways in the past, or who currently do so or will in the future. Thus, even if radionuclide releases did occur from the HFIR ponds to White Oak Creek, exposures to radionuclide releases from the creek via the Clinch River and the

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		Lower Watts Bar Reservoir would not be expected to cause adverse health effects.
81	Page 36, Line 9. Offsite Locations. Name the top twenty radioactive contaminants that have actually been released to the Clinch River and Watts Bar Reservoir from WOC. Give an estimate of the respective curie loads of each of these radionuclides. Cite the actual levels of these radionuclides in fish sampling data in the OREIS database. The DOE ASERs (Annual Site Environmental Reports) contain data volumes that are available to stakeholders. For example, these data volumes cite that Cs-137 concentrations in fish filets is 0.44 pCi/gm, which should be a significant risk driver for further investigations far downstream of DOE ORR. If the sediments contain Cs-137 and Sr-90 then the bottom feeding fish surely contain these radionuclides as well. This is amply demonstrated in both DOE's ASERs and its OREIS database. (*Comment received on the initial release PHA dated December 2003.)*	As presented in Section III.B.2. Past Exposure in the final PHA and discussed in the Oak Ridge Health Agreement Steering Panel (ORHASP) report titled *Releases of Contaminants from Oak Ridge Facilities and Risks to Public Health* (available at http://www2.state.tn.us/health/CEDS/OakRidge/ORHASP.pdf), an initial evaluation conducted by Task 4 of the Tennessee Department of Health's Reports of the Oak Ridge Dose Reconstruction (Task 4 report) identified 24 radionuclides that were released to the Clinch River via White Oak Creek from 1944 to 1991: americium 241, barium 140, cerium 144, cobalt 60, cesium 137, europium 154, hydrogen 3, iodine 131, lanthanum 140, niobium 95, neodymium 147, phosphorus 32, promethium 147, praseodynium 143, plutonium 239/240, ruthenium 106, samarium 151, strontium 89, strontium 90, thorium 232, uranium 235, uranium 238, yttrium 91, and zirconium 95. The Task 4 team identified eight key radionuclides of potential concern based on its screening analysis: cobalt 60, strontium 90, niobium 95, ruthenium 106, zirconium 95, iodine 131, cesium 137, and cerium 144. Table 3 in the final PHA presents the peak annual releases in curies for these key radionuclides. In Section III.B.3. Current and Future Exposure of the final PHA, the maximum radionuclide concentrations are presented for Lower Watts Bar Reservoir sediment (Table 13), surface water (Table 14), and fish (Table 15). In addition, as mentioned in the final PHA, ATSDR obtained data in electronic format from the Oak Ridge Environmental Information System (OREIS) (detailed throughout the document and in Section II.F.4.). ATSDR used the OREIS data, covering the time period from 1989 to 2003, to evaluate the current and future exposures and doses related to releases from White Oak Creek. Samples included surface waters collected from the Lower Watts Bar Reservoir and sediments from the associated shorelines. ATSDR also evaluated biota data, including fish, geese, and turtle samples. ATSDR analyzed samples for rivers in the watershed that included the Clinch River below Melton Hill Dam and the Tennessee River below the mouth of the Clinch River. For comparison purposes, ATSDR reviewed data collected from background locations (Emory River, streams that feed into the Clinch River, the Clinch River above the Melton Hill Dam, and the Tennessee River upstream of the Clinch River). DOE's annual site environmental reports (ASERs) are included in OREIS. Please refer to Section II.F.4 of the final PHA and the response to comment 54 for a detailed discussion on OREIS.
82	Page 36, Line 9. Offsite Locations. The ATSDR BRA (Baseline Risk Assessment), which unfortunately established PCBs, instead of strontium-90 and cesium-90, is fatality and irrevocably flawed and must be redrafted. ATSDR's finding of 'No Public Health Risk' is irresponsible at best and	As a clarification, the commenter refers to a U.S. Department of Energy (DOE) baseline risk assessment in the remedial investigation/feasibility study for Clinch River/Poplar Creek available at http://www.osti.gov/bridge/servlets/purl/226399-5omhIT/webviewable/226399.pdf. This was not an assessment conducted by ATSDR. It is important to note that the findings of the baseline risk assessment were approved and

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	possibly fraudulent. This BRA is not supported by the high levels of Sr-90 and Cs-137 documented in DOE's own fish sampling data in DOE's own OREIS database. As long as these radioactive sediments remain in place they are and will continue to be mobilized in the environment and bioaccumulation in fish and other aquatic organisms — and on to those people consuming them. The risk of consuming PCBs in these fish, compared to the risks of ingesting radioactively contaminated fish is literally a 'red herring' foisted onto stakeholders in these downstream communities in order to quell their legitimate public health concerns. The citizens of Oak Ridge, Kingston, Spring City, and all other communities downstream absolutely reject out-of-hand ATSDR's patronizing, condescending finding of 'No Risk' from these contaminated sediments. Stakeholders demand that ATSDR immediately reorient itself to the reality of the existing DOE and TVA fish tissue data. ATSDR must attempt to redeem itself by reworking this fatally flawed BRA and try to earn the trust of these stakeholders now, which it certainly neither has nor deserves. (*Comment received on the initial release PHA dated December 2003.)*	agreed to by the U.S. Environmental Protection Agency (EPA), the Tennessee Department of Environment and Conservation (TDEC), and DOE. ATSDR's findings in this final public health assessment concur with the findings of the baseline risk assessment that radionuclides in fish, sediment, and surface water in the Clinch River do not present a health hazard. TDEC's Division of Water Control is responsible for issuing and posting fish advisories. Evaluating fish tissue problems in the state of Tennessee involves a multi-agency effort, comprised of DOE, EPA, TDEC, the Tennessee Wildlife Resources Agency (TWRA), and the Tennessee Valley Authority (TVA). An abundance of data are available on contaminants in fish in these systems, including data collected by TVA, DOE, TWRA, and TDEC. These agencies use Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) criteria to analyze fish tissue in these waterways, which applies EPA risk assessment to evaluating potential exposures to contaminants in fish. DOE, TDEC, and EPA have responsibilities under CERCLA, but the state has ultimate responsibility for the advisories. The state fish advisories are available at: http://www.state.tn.us/twra/fish/contaminants.html. Although radionuclides and other contaminants might be present in fish in the Clinch River and the Lower Watts Bar Reservoir, **only PCBs** have been found at levels in particular species of fish that could potentially cause adverse health effects. This is why radionuclides are not part of the advisories for these waterways—they have not been detected at harmful levels in these water systems. These agencies are basing their advisories on numerous data collected over several years by different entities, all of which show that radionuclides are not present in fish in the Lower Watts Bar Reservoir and the Clinch River at levels that could cause adverse health effects. ATSDR's evaluation in this public health assessment concurs with the findings of the state, the EPA, and these other entities. In addition, ATSDR is preparing a public health assessment that will evaluate PCB releases from the three main ORR facilities: X-10, Y-12, and K-25. When available, copies of ATSDR's public health assessment on PCBs can be obtained by contacting ATSDR's Information Center toll-free at 1-888-422-8737.
83	Page 39, Line 4-5. Any objective environmental scientist, with access to the OREIS database, can demonstrate many instances as to why this uninformed statement is wholly fallacious. (*Comment received on the initial release PHA dated December 2003.)*	As reported in the record of decision (ROD) for the Lower Watts Bar Reservoir, human health standards would not be met if deep channel sediments containing cesium 137 were dredged and placed in a residential area. The ROD concluded, however, that these sediments, if left in place and undisturbed, pose no human health threat: no exposure pathway exists to the contaminants in the deep sediment. ATSDR has reviewed and evaluated the Oak Ridge Environmental Information System (OREIS) data and reports indicating the presence of radionuclides in the deep channel sediments (beneath several

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		meters of water and 40 to 80 centimeters of sediment) of the Lower Watts Bar Reservoir. In addition, in 1996 ATSDR prepared a health consultation to review various potential exposures associated with the reservoir. We concluded that the current levels of radiological contaminants in sediment posed no public health hazard and recommended that reservoir sediment not be removed, disturbed, or disposed of without prior careful review of sediment sampling data for the specific area. Furthermore, as discussed in the final PHA in Section III.B.3. Current and Future Exposure, since February 1991 the Watts Bar Interagency Agreement has set guidelines related to any dredging in the Watts Bar Reservoir and for reviewing potential sediment-disturbing activities in the Clinch River below Melton Hill Dam. Under this agreement, the Watts Bar Reservoir Interagency Working Group (WBRIWG) reviews permitting and other activities, either public or private, that could possibly disturb sediment, such as erecting a pier or building a dock. The WBRIWG consists of the U.S. Department of Energy (DOE), the U.S. Environmental Protection Agency (EPA), the U.S. Army Corps of Engineers (USACE), the Tennessee Department of Environment and Conservation (TDEC), and the Tennessee Valley Authority (TVA) because of their permit authority or their knowledge of the sediment contamination and how that contamination if disturbed could affect the public. Therefore, based on the enormous amount of data available, ATSDR's own independent evaluation of the deep channel sediment at the reservoir, and controls in place to prevent the disturbance of deep channel sediment, ATSDR believes that this finding approved by DOE, EPA, and TDEC is supported by the available data indicating that because of the absence of an exposure pathway, people would not come in contact with cesium 137 buried in deep channel sediment.
84	Page 43, Figure 13. Map of the White Oak Creek Study Area. The study area does not extend far enough downstream. It should include at least all downstream communities that appear in the Spatial Query Tool of the DOE OREIS database. More appropriate would be to include other sampling sites that TVA has included in its analyses of radioactively contaminated fish. Yes, these data are available too, if stakeholders ask for them. Certainly, ATSDR should be interested too. More appropriately, the study area should extend to at least to the TVA embayment at Mocassin Bend in Chattanooga — if not the entire TVA dendritic system, which extends to Paducah, KY. (*Comment received on the initial release PHA dated December 2003.)*	The White Oak Creek study area (see Figure 11 in the final PHA) consists of the area along the Clinch River from the Melton Hill Dam to the Watts Bar Dam. Past studies have shown that most sediment-associated contaminant releases from the reservation have collected in the Lower Watts Bar Reservoir. Concentrations of ORR-related sediment-associated contaminants have been detected at much lower levels in reservoirs located downstream of the Watts Bar Dam, and accordingly, also at concentrations well below levels found to be of human health concern. ATSDR extended its evaluation in this public health assessment to the Watts Bar Dam because this is the downstream boundary of the reservation. No public health hazards associated with ORR releases have been identified downstream of Watts Bar Dam. This information is based on many past studies and a baseline risk assessment prepared for the Lower Watts Bar Reservoir. Please see the record of decision for the Lower Watts Bar Reservoir for more information at http://www.epa.gov/superfund/sites/rods/fulltext/r0495249.pdf. The record of decision was

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		issued by the U.S. Department of Energy (DOE), as well as approved by the U.S. Environmental Protection Agency (EPA) and the Tennessee Department of Environment and Conservation (TDEC). The baseline risk assessment indicated that standards for environmental and human health would not be reached if deep channel sediments with cesium 137 were dredged and placed in a residential area and if people consumed moderate to high quantities of specific fish that contained increased levels of PCBs. But there is no exposure pathway to this deep channel sediment. Thus, areas of the Lower Watts Bar Reservoir do not pose a health hazard for radionuclides. Areas further downstream—where contaminants associated with the ORR have been detected at much lower concentrations than at the Lower Watts Bar Reservoir and at levels not of public health concern would therefore not need to be included in this evaluation of White Oak Creek radionuclide releases to the Clinch River and the Lower Watts Bar Reservoir; they are not an ORR contaminant-related public health hazard.
85	Page 66, Line 3. Why is the DOE OREIS database no longer readily accessible to the public? ATSDR should take immediate steps to insist that DOE be more flexible in granting groups like institutions of higher learning, civic community organizations, churches, civil rights organizations, non-governmental environmental advocacy groups, and indeed any 'legitimate' stakeholder group access to this robust database. These user groups should be given group accounts to the OREIS database, along with the easy to read OREIS Users Guide. ATSDR should take immediate steps to facilitate stakeholders access to this crucial environmental data. Think of the millions of dollars of taxpayers money that went into archiving this data into OREIS. Downstream stakeholders have a fundamental Right-to-Know about the sampling data in OREIS which amply demonstrates that here should, in fact, be considerable concern about the risk manage of environmental releases from DOE ORR. There needs to be a 'sea change' at ATSDR in the project management of this PHA — it is superficial and simply attempts to lull downstream stakeholders into a woefully false sense of security. (*Comment received on the initial release PHA dated December 2003.)*	The U.S. Department of Energy (DOE) created the Oak Ridge Environmental Information System (ORIES)—an electronic data management system that integrates an abundance of environmental data into a single database. OREIS was developed to facilitate access to environmental data related to ORR operations while also maintaining data quality. DOE's objective was to ensure that the database had long-term retention of the environmental data and useful methods to access the information. OREIS contains data related to compliance, environmental restoration, and surveillance activities. Information from all key surveillance activities and environmental monitoring efforts is entered into OREIS. These include but are not limited to studies of the Clinch River embayment and the Lower Watts Bar, as well as annual site summary reports. Before September 11, 2001, OREIS was accessible to the public. Following these events, however, access of OREIS was restricted due to sensitive information contained within the database, such as geographic information system (GIS) data identifying locations of buildings on the Oak Ridge Reservation. Today, DOE and its contractors and subcontractors, the U.S. Environmental Protection Agency (EPA), the Tennessee Department of Environment and Conservation (TDEC), ATSDR, and other agencies have access to OREIS through officially obtained user ids and passwords. Members of the public can request a user id and password, but the applicant would have to be sponsored by a DOE or other government representative. The public can contact bjc-oreis@bechteljacobs.org to request a user account and password, but only those with proper sponsorship will be provided access. Further, OREIS could be accessible to the public again soon; DOE's subcontractors are in the process of working on the database so that it can be made publicly available in the near future.

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		ATSDR is not involved in the management of OREIS or in providing people with access to the database. We understand DOE's need to remove the database from public access due to the sensitivity of information within OREIS, but again, this was not our decision and we have no involvement in OREIS other than using the data contained within it.
86	Page 116, Actual Comment #11, third paragraph, Line 2. The list of potential contaminants of significant concern is inadequate and incomplete. The ORHASP Final Report, in fact, lists eighteen cardinal contaminants of concern as having been released off site by DOE ORR. (*Comment received on the initial release PHA dated December 2003.)*	As a clarification, the statement referenced by the commenter is not a list of potential contaminants of concern. Instead, it is a list of the contaminants for which ATSDR is preparing public health assessments. The rationale for the selection of these contaminants is detailed below. During Phase I and Phase II of the Oak Ridge Health Studies, the Tennessee Department of Health (TDOH) conducted extensive reviews and screening analyses of the available information and identified four hazardous substances related to past ORR operations that could have been responsible for adverse health effects: radioactive iodine, mercury, polychlorinated biphenyls (PCBs), and radionuclides from White Oak Creek. In addition to the dose reconstruction studies on these four substances, the TDOH conducted additional screening analyses for releases of uranium, radionuclides, and several other toxic substances. To expand on TDOH efforts—but not duplicate them—ATSDR scientists conducted a review and a screening analysis of the department's Phase I and Phase II screening-level evaluation of past exposure (1944–1990) to identify contaminants of concern for further evaluation. Using this review, in addition to this public health assessment on X-10 radionuclide releases to White Oak Creek, ATSDR scientists are conducting public health assessments on: Y-12 uranium releases, X-10 iodine 131 releases, Y-12 mercury releases, K-25 uranium and fluoride releases, PCB releases from X-10, Y-12, and K-25, and other topics such as the Toxic Substances Control Act (TSCA) incinerator and off-site groundwater. In conducting these public health assessments, ATSDR scientists are evaluating and analyzing the data and findings from previous studies and investigations to assess the public health implications of past, current, and future exposures. Contrary to the commenter's statement, the Oak Ridge Health Agreement Steering Panel (ORHASP) (see page 72 of its final report at http://www2.state.tn.us/health/CEDS/OakRidge/ORHASP.pdf) lists the primary Oak Ridge Reservation contaminants as iodine 131, mercury, PCBs, and White Oak Creek radionuclide releases—the same as those identified during the Oak Ridge Dose Reconstruction. The statement questioned by the commenter in ATSDR's public health assessment for which public health assessments are being conducted lists the same contaminants identified as priority contaminants by ORHASP. Further, ATSDR is conducting assessments on additional topics because of community concern, including the

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		TSCA Incinerator, uranium and fluoride releases from K-25, and off-site groundwater.
87	Page 125, Line 6. This statement is not true. This PHA is fatally flawed and should be redone in its entirety. Next time try to have it prepared by competent, credentialed health professionals. This PHA in definitely lacking the caliber of talent that is elemental in such a serious task. Peoples' health and lives are at stake and ATSDR should not be so cavalier in assigning the preparation of this PHA to non-medical staff. We stakeholders, many of us already sick, demand that the next time ATSDR tries to float this PHA that it have at least one medical doctor in charge of its preparation and at least three other physicians sign off on it. ATSDR might think that our health and welfare can be easily discounted by such an inane, superficial, and incompetently prepared PHA. We stakeholders and the State of Tennessee know better and we are not going to stand for this level of tyrannical federal arrogance that ATSDR has demonstrated in its attempt to foist unto us this fatally flawed PHA. What health professional – meaning a physician or nurse, and not simply a non-medical staff member without any medical or nursing credential – would ever risk putting his or her signature on this – it would be indefensible in federal and state court. Note, by the way, that there is not, in fact any credentialed health professional that ever did sign off on this PHA. See comment regarding the PREPARERS OF REPORT. Of all the fleet of well credentialed physicians that ATSDR has on its payroll, not one, repeat, not one of them has committed his or her signature to this PHA. Stakeholders believe that this is because they well know that if a fatally flawed PHA looks like a duck, walks like a duck, and quacks like a duck – it might be a duck, or some other fowl. (*Comment received on the initial release PHA dated December 2003.)*	The referenced conclusion was altered slightly in the final public health assessment to the following: "ATSDR concludes that exposures to X-10 radionuclides released from White Oak Creek to the Clinch River and to the Lower Watts Bar Reservoir are not a health hazard. Past and current exposures are below levels associated with adverse health effects and regulatory limits. Adults or children who have used, or might continue to use, the waterways for recreation, food, or drinking water are not expected to have adverse health impacts due to exposure. ATSDR has categorized those situations as posing *no apparent public health hazard* from exposure to radionuclides related to X-10. This classification means that people could be or were exposed, but that their level of exposure would not likely result in any adverse health effects." Contrary to this commenter's opinion, this conclusion is factual based on ATSDR's thorough evaluation of data, exposure situations, and public health activities associated with radionuclides released from White Oak Creek to the Clinch River and the Lower Watts Bar Reservoir. Please note that the White Oak Creek Radionuclide Releases PHA underwent several phases of review before its final release, including an internal ATSDR review, a data validation review by other agencies (i.e., the U.S. Department of Energy [DOE], the U.S. Environmental Protection Agency [EPA], and the Tennessee Department of Environment and Conservation [TDEC]), an Oak Ridge Reservation Health Effects Subcommittee (ORRHES) review, an independent external peer review, and a public comment review. During the agency's internal review process, individuals within the agency who have the proper background (e.g., toxicology and health physics) carefully reviewed the document for technical content and other aspects. After reviewing comments from other agencies received during the data validation review, ATSDR made changes to the document as appropriate. ORRHES members consisted of individuals representing different expertise, backgrounds, geographic areas, and interests from the communities surrounding the Oak Ridge Reservation. ORRHES had technical experts in toxicology, health physics, medicine, geology, and other disciplines as well. ORRHES members carefully discussed all suggested editorial and technical changes and then submitted recommendations to ATSDR for changing the document. Through its external peer review process, ATSDR's Office of Science had three scientific experts review this public health assessment. The agency's peer review process allows an external, thorough evaluation of this PHA by experts in the field that this assessment covers—health physics. During the external review process, individuals (not employed by ATSDR or the CDC) independently reviewed this document and provided their unbiased, scientific opinions of it (see Appendix H for the peer reviewer comments and ATSDR's responses). ATSDR also presented the data and information used in this public health assessment several times at public meetings, including work group and

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		ORRHES meetings. In addition, during the public comment period, any member of the public, including physicians, nurses, and other members of the community, can provide comments to ATSDR, which are included within this appendix. ATSDR uses a multi-disciplinary approach for reviewing public health assessments, including having experts in toxicology, medicine, health physics, and other disciplines review our work. All peer reviewers approved of the assessment and found no major flaws that would invalidate ATSDR's conclusions and recommendations. In the words of one peer reviewer: "You [ATSDR] have done a good job under very difficult circumstances with a lot of unwanted publicity and carping. The science under the report is very good and the report is well written in a very good manner that is suitable for both an informed and interested public and the scientific community."
88	Appendix C. A Conservative Approach in Radiation Dose Assessment, Issues Associated with Being Protective or Overestimating Radiation Doses, ATSDR can become more sensitive to the legitimate concerns of fish consuming stakeholders downstream of DOE ORR by commissioning a subsistence fisher study. (*Comment received on the initial release PHA dated December 2003.)*	This appendix was removed during subsequent revisions and is not included in the final PHA.
89	Appendix D. Implications of Exposure to the Eight Radionuclides Identified for Further Evaluation in the D*ose Reconstruction Report*, Page D-1, Line 1. See comment for Page 125, Line 25. Also, this list of only potential contaminants of significant concern is inadequate and incomplete. The ORHASP Final Report, in fact, lists eighteen cardinal contaminants of concern as having been released off site by DOE ORR. (*Comment received on the initial release PHA dated December 2003.)*	This appendix was removed during subsequent revisions and is not included in the final PHA. Please see Table 2 and Table 3 in the final PHA, as well as information on the screening process from Task 4 of the Tennessee Department of Health's Reports of the Oak Ridge Dose Reconstruction (Task 4 report) described in Section III.B.2. Past Exposure.
90	Appendix D. Implications of Exposure to the Eight Radionuclides Identified for Further Evaluation in the *Dose Reconstruction Report,* Page D-16, Line 22. This is not true. If pregnant mothers are consuming Clinch River fish, or indeed any fish taken from many other downstream waters, this most probably has already occurred. (*Comment received on the initial release PHA dated December 2003.)*	This appendix was removed during subsequent revisions and is not included in the final PHA. Please see Section VII of the final PHA for a discussion of potential exposures to pregnant women, including ingestion of Clinch River fish.
91	Appendix D. The brief of the Watts Bar Reservoir (WBR) exposure investigation assumes that an average fish consumption rate of 66.5 g/day corresponds to a median of 33.1 meals per year. However, the calculated portion size for this assumed combination of numbers is 26 ounces per	To clarify the statements made by this commenter, the average daily consumption rate presented in the Watts Bar Exposure Investigation brief is for fish and turtles—not only fish. Only persons who consumed **moderate to large amounts** of fish and turtles from the Watts Bar Reservoir (generally more than 15 grams/day) were included in this investigation. The

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	meal, which is unreasonably high. Therefore, the original data from the WBR exposure investigation needs to be re-examined to determine the proper relationship between the two given numbers.	average fish and turtle consumption rate (66.5 grams per day) presented in this brief is based on self-reported estimations of actual (not assumed) consumption frequency and meal size from 116 individuals who participated in the exposure investigation. Following a review of these comments, ATSDR evaluated the data further. A rate of 66.5 grams per day is slightly more than two 8-ounce fish meals per week, which would be expected among moderate to large fish and turtle consumers. The median value presented of 33.1 meals per year is, however, much lower than would be expected from this population. Therefore, the value of 33.1 meals per year was removed from the exposure investigation brief in the final PHA.
92	The nature of the Clinch River/WOC plume should be described as lying adjacent to the DOE property where it dissipates before reaching the K-25 water intake, a point of frequent sampling and overview by the State.	We agree and recognize that the concentration of contaminants released from White Oak Creek is diluted by the tremendous amount of water in the Clinch River.
93	It should be stressed that the dilution ratio at the Clinch River/White Oak Creek confluence is in excess of 1000 and that the Kingston water intake is located in the Tennessee River just above its confluence with the Clinch. The Tennessee River supplies an additional dilution factor for downstream water usage.	Thank you for your comment. Changes have been made in Section I. Summary and under the Clinch River in Section III.B.3. of the final PHA.
94	No medical professionals, meaning no medical doctor or nurse, have been included in the preparation of this PHA. Considering the significant number of omissions in delineating actual exposures for downstream stakeholders, we recommend that at least one qualified physician from ATSDR's large complement of medical staff on their payroll be in charge of the preparation of a complete redraft of this PHA. Further, stakeholders insist that this redrafted PHA be internally peer reviewed by at least three other of its qualified physicians. These physicians should attach their signatures and state license numbers to the PHA's front page. This should prevent further flagrant omissions by ATSDR evidenced in this one. Additionally, attaching medical doctor signatures to this PHA will facilitate appropriate rectification of any future 'omissions' through federal tort action. (*Comment received on the initial release PHA dated December 2003.)*	The White Oak Creek Radionuclide Releases PHA underwent an internal ATSDR review, a data validation review by other government agencies (i.e., the U.S. Department of Energy [DOE] and the Tennessee Department of Environment and Conservation [TDEC]), and an external review. Through its external peer review process, ATSDR's Office of Science had three scientific experts review this public health assessment. The agency's peer review process allows an external, thorough evaluation of this PHA by experts in the field that this assessment covers: health physics. Individuals within the agency who have the proper background (e.g., toxicology and health physics) reviewed the document during the agency's internal review process. ATSDR and CDC do have physicians on their staff; that said, however, individuals within the agency who have the proper background reviewed the document during the agency's internal review process. During the external review process, individuals (not employed by ATSDR or the CDC) independently reviewed this document and provided their unbiased, scientific opinions of it (see Appendix H for the peer reviewer comments and ATSDR's responses). During this external review period, any member of the public, including physicians, nurses, and other members of the community, can provide comments to ATSDR. ATSDR uses a multi-disciplinary approach for reviewing public health assessments, including having experts in toxicology, medicine, health physics, and other disciplines review our work.

	Comment	ATSDR's Response
		All peer reviewers approved of the assessment and none found any major flaws that would invalidate ATSDR's conclusions and recommendations. In the words of one peer reviewer: "You [ATSDR] have done a good job under very difficult circumstances with a lot of unwanted publicity and carping. The science under the report is very good and the report is well written in a very good manner that is suitable for both an informed and interested public and the scientific community."
Editorial Comments		
95	Page 2, Line 13: "radionuclides from White Oak Creek," The specific radionuclides should be identified here. Uranium is specified, as is Iodine-131; why not the others such as Cs-137, Sr-90, and Cobalt-60 (Co-60). For starters, identify the specific radionuclides being evaluated here. (*Comment received on the initial release PHA dated December 2003.)*	Uranium and iodine131 are discussed here, but not in the context of listing radionuclides that were released from White Oak Creek. Instead, this referenced part of the document is listing the PHAs ATSDR is preparing because these particular contaminants required further evaluation based on ATSDR's review, the screening analysis of the Tennessee Department of Health's (TDOH's) Phase I and II screening-level evaluation of past exposure (1944–1991), and community concerns. Thus, the text reads: "…ATSDR scientists are conducting public health assessments on X-10 iodine 131 releases, Y-12 mercury releases, K-25 uranium and fluoride releases, PCB releases from X-10, Y-12, and K-25, and other topics such as the Toxic Substances Control Act (TSCA) incinerator and off-site groundwater." This statement is not, however, listing the contaminants released from White Oak Creek. In fact, in this context, uranium refers to releases from the Y-12 plant and the K-25 site and iodine131 refers to releases from the X-10 site, but not into White Oak Creek. TDOH's Oak Ridge Health Studies, conducted over 9 years, investigated historical releases from the ORR facilities to see if these releases could have caused health problems for nearby residents. The project included dose reconstruction studies focusing on four areas: ▪ Iodine131 releases from X-10 ▪ Mercury releases from the Y-12 Plant ▪ PCB releases from ORR facilities ▪ X-10 radionuclide releases to the Clinch River via White Oak Creek All of the final reports from the Oak Ridge Health Studies are available online at http://www2.state.tn.us/health/CEDS/OakRidge/ORidge.html. In addition, you may contact ATSDR's Information Center toll-free at 1-888-422-8737 for copies of ATSDR public health assessments that evaluate contaminants released from these facilities.
96	P. 4. Line 23. Define "Screening Index."	The comment is noted. The text was changed in the final PHA by adding "or calculated probabilities of developing cancer" after the term screening indices.
97	Pp. 5-6. On pp. 5-6, the statement is made that radiation lifetime doses to critical organs (e.g. bone, lower large intestine, red bone marrow, breast,	This information is presented in various parts of the document to correspond to different portions of the evaluation conducted as part of the public health assessment process. The

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	and skin) are less than ATSDR's comparison values. Then, on pp. 65-66, 82, and in the footnotes to Table 11 on p. 84, it is explained that the individual annual organ doses are each multiplied by "weighting factors," the products summed, and the sums multiplied by 70 to get lifetime effective whole-body doses. However, mention is not made on pp. 82 or 84 that the "weighting factors" are listed in Table 6 on p. 66, nor is the reader directed to Table 22, on p. 111 where the calculated doses are finally compared to the "comparison values." This information is out of order and too strung out. It should be collected and presented in one place.	information referred to is detailed in the summary, in the introductory information describing the exposure evaluation process, in the description of Task 4 of the Tennessee Department of Health's Reports of the Oak Ridge Dose Reconstruction (Task 4 report) and ATSDR estimated radiation doses, in the summary table for past radiation doses, and in the public health implications section. The information is intentionally presented in these various sections to help readers as they go through the different portions of the evaluation. Although these sections will not all be put into one place, changes were made as suggested to refer the reader to Table 6 in the notes for Table 11. In addition, the following sentence was added after Table 11 (page 88) regarding Table 22: "These calculated doses have been screened against the comparison values found in Table 22 of Section IV. Public Health Implications."
98	P. 6. Line 9. "…that are not considered to be a public health hazard."	The comment is noted. The text was changed in the final PHA.
99	P. 7. Line 12. "of chemical contaminants…."	The comment is noted. The text was changed in the final PHA.
100	P. 7. Line 17. "ATSDR estimated committed effective…."	The comment is noted. The text was changed in the final PHA.
101	P. 7. Line 18. "for adults and children…."	The comment is noted. The text was changed in the final PHA.
102	Page 7, Line 24. There is an incomplete sentence at the end of this page. Content of this passage doesn't flow with the discussion resuming at the top of page 10. (*Comment received on the initial release PHA dated December 2003.)*	This incomplete sentence was fixed in subsequent versions of the document and the two passages now flow together. The referenced passages are two separate paragraphs—not one continuous paragraph as it might have appeared since the last sentence was incomplete in this former version of the document. To clarify further, the paragraph on former page 7 provided a general overview and background of the main ORR facilities: X-10, Y-12, K-25, and S-50. The next paragraph on former page 10 narrows the focus to discussing only X-10 because this PHA evaluates those radionculides released from this facility that entered White Oak Creek.
103	P. 8. Line 11. Define "screening comparison value."	The following information was added into a text box in the final PHA to define this term: "Comparison values (CVs) are doses (health guidelines) or substance concentrations (environmental guidelines) set well below levels known or anticipated to result in adverse health effects. *Health guidelines* are derived based on data drawn from the epidemiologic and toxicologic literature with many uncertainty or safety factors applied to ensure that they are amply protective of human health. *Environmental guidelines* are derived from the health guidelines and represent concentrations of a substance (e.g., in water, soil, and air) to which humans may be exposed via a particular exposure route during a specified period of time without experiencing adverse health effects. During the public health assessment

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		process, ATSDR uses CVs as screening levels. Substances detected at concentrations or doses above CVs might be selected for further evaluation."
104	He suggested changing the word "reasonably" on line 25 of page 8 to better suit the public.	The comment is noted. The word "reasonably" was changed to "be expected to."
105	Page 8, Figure 1. Location of the DOE ORR. Make sure the fish sampling sites are identified as such. Add a legend note to explain that the 'CRMs' are sampling sites with extensive and continuous fish sampling data archived into the OREIS. Also mention that this data, now withheld from the public, is still available to group users, such as non-governmental organizations, institutions of higher learning, environmental advocacy groups, civil rights groups, church groups, et al. Mention that robust fish sampling data in OREIS dates from 1985. (*Comment received on the initial release PHA dated December 2003.)*	Please refer to the Oak Ridge Reservation Annual Site Environmental Reports (ASERs) for information on areas sampled during investigations. These reports are available online at http://www.ornl.gov/sci/env_rpt/ and the findings are also included in the Oak Ridge Environmental Information System (OREIS). Also, the Tennessee Department of Environment and Conservation (TDEC), DOE Oversight Division, has published its environmental monitoring plan online at http://www.state.tn.us/environment/doeo/pdf/EMP2005.pdf. This indicates the areas where fish sampling will be conducted.
106	Page 9, Figure 2. Original and Current ORR Boundaries. The 'Current' boundaries are not visualized on this map. It is impossible to visualize the information in the legend in black and white because it is probably in color: Land Transferred from DOE Ownership, Pending Transfer, and Leased Land. Add to this map all land that has been 'transferred' without substantive environmental cleanup. Also add a note to this map in the legend that DOE is still responsible for any 'misadventures' in its Land Use Controls (LUCs) in the event any future lease holders of transferred become sick, injured, or die consequent to properties on this site being transferred without actually fulfilling the legal requirements of CERCLA. For example, if any workplaces on these transferred sites remain contaminated and a leaseholder business decides to place a daycare center on site at that workplace, then DOE would still be liable for such misadventure, despite its 'property transfer.' In other words, there should be explicit mention on this map, which depicts property transfers and leased land that, in fact, DOE is still liable for subsequent injuries, illnesses, and/or deaths which might devolve from a 'land rush' to transfer property with marginal and/or environmental cleanup beforehand. (*Comment received on the initial release PHA dated December 2003.)*	The April 2005 public comment PHA and the final PHA present this map in color. The current lands comprising the DOE Oak Ridge Reservation, land transferred from DOE ownership, lands pending transfer, and leased lands are all identified by different colors on the map and outlined in the legend. Section 120 (h) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) requires documentation of the condition of federal lands upon sale or transfer, and it establishes the federal government as the responsible party for any remedial action found to be necessary after land transfer. Under a Covenant Deferral Request, DOE can transfer properties if it can show that the land is protective for the intended use. This enables DOE to transfer properties before CERCLA remedial activities are completed. Properties could only be transferred if they were considered safe for their intended future use. Moreover, ATSDR is evaluating wastes that traveled off site only—not wastes remaining on the reservation. Through various measures, including monitoring, remediation, institutional controls, engineering controls, and sampling, DOE continues to evaluate contaminant releases on the reservation and to mitigate contaminants from leaving the ORR. ATSDR considered these measures, including institutional and engineering controls, and evaluates and discusses them in the final PHA.

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107	Page 10, Line 1. There appears to be missing text at the top of this page because the content is out of place because it does not flow with the end of page 7, the immediate preceding passage. (*Comment received on the initial release PHA dated December 2003.)*	No incomplete sentence was found at the end of the page on this previous version of the document. The passages being referenced are actually two separate paragraphs—not one continuous paragraph as it might have appeared since the last sentence ended at the bottom of page 7 in this previous version. It is clear that these are two separate paragraphs in the final PHA. To clarify further, the paragraph on former page 7 provided a general overview and background of the main ORR facilities: X-10, Y-12, K-25, and S-50. The next paragraph on former page 10 narrows the focus to discussing only X-10, given that this PHA evaluates radionculides released from this facility that entered White Oak Creek. Thus, ATSDR believes that these passages do indeed flow in the order they are presented within the document, as the initial paragraph provides a general overview of the facilities and the following statements focus on the facility of interest for this PHA.
108	P. 12. Line 15. Clinch River Mile (CRM) is defined, but Fig. 3 presents the acronym "CRK," that is not defined in the text, the figure, nor in the list of acronyms. The conversion 1 km = 0.6214 mi. should also be given in the nomenclature, or in Fig.3. It should also be noted that CRK 33 is also CRM 20.5, which is the reference location on Jones Island.	Thank you for your comment. To be consistent throughout the document, the Clinch River Kilometers (CRKs) have been replaced with the equivalent distances in Clinch River Miles (CRMs).
109	Page 14: Figure 5. X-10 Facility Time Line: Missing depiction. (*Comment received on the initial release PHA dated December 2003.)*	This figure was inadvertently missing from the December 2003 version, but it is included in subsequent revisions of the document, including the final PHA.
110	Page 15, Line 27. Which contaminants ended up on the Clinch River? Name them and the approximate curie load of each of those contaminants which are radioactive. (*Comment received on the initial release PHA dated December 2003.)*	This PHA evaluates the releases of radionuclides—not all contaminants—to the Clinch River and the Lower Watts Bar Reservoir from the X-10 site via White Oak Creek. The estimated discharges (in curies) of radionuclides released to the Clinch River via White Oak Creek are presented in Table 2 of the final PHA.
111	P. 15. Line 20. "nuclear fission products"	The comment is noted. The text was changed in the final PHA.
112	Page 16, Figure 6. Location of the Gunite Tanks at the X-10 Site. Define 'WAG', 'gunite', and 'grout sheets' in the legend. Also mention, both here and in the text, that 'gunite' is actually just concrete and state the average life expectancy of concrete (approximately 84 years). This means that the integrity these aging 'gunite tanks' are most probably already compromised. Identify on this figure those gunite tanks that are known to be leaking by DOE, ATSDR, EPA, and TDEC collectively. (*Comment received on the initial release PHA dated December 2003.)*	The legend is a guide for terms used in the figure; WAG, gunite, and grout sheets are not presented in the figure. The following was added as a footnote to define "gunite": "Tanks were constructed of a water, concrete, and sand mixture called 'gunite,' which was sprayed over a wire mesh and steel reinforcing rod frame." Most of the mixed waste was removed from the gunite and associated tanks in the 1980s. In September 1997, an interim record of decision identified these tanks as a priority for clean up, partly because of the risk to the public, to workers, or, if a tank leaked or collapsed, to the environment. A total of 87,000 gallons of sludge and 250,000 gallons of liquid waste were treated and transferred off site. The action was completed in September

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		2000. The tanks were empty, left in place, and grouted in 2001. Information on the gunite tanks suggests that these remedial actions were conducted to **prevent** leaks, not because leaks had already taken place. Thus, ATSDR is unable to identify leaking tanks on the figure because evidence supports that the waste was removed before any leakages occurred. In addition, the life expectancy of concrete is irrelevant for this discussion because the tanks are empty. Please refer to Appendix B in the final PHA for more details on these remedial activities.
113	P. 17. Fig. 5 is impossible to read.	An 11 x 17 size of this time line was incorporated into the final PHA.
114	Page 17, Line 14. Name the 'top twenty' of these contaminants by 'curie load' and identify the 'top twenty' radionuclides contributed by these facilities. Provide two pie charts for this information. (*Comment received on the initial release PHA dated December 2003.)*	To be clear, this PHA **only** evaluates the releases of radionuclides to the Clinch River and the Lower Watts Bar Reservoir from the X-10 site via White Oak Creek. The estimated discharges (in curies) of radionuclides released to the Clinch River via White Oak Creek are presented in Table 2 of the final PHA. Also, a detailed discussion of the 24 radionuclides initially evaluated and the process of determining particular contaminants for additional screening are presented under Task 4 Screening Assessment in Section III.B.2. Past Exposure (1944-1991). You can also refer to the Oak Ridge Dose Reconstruction Task 4 report online at http://www2.state.tn.us/health/CEDS/OakRidge/WOak1.pdf for more information on estimated radionuclide releases.
115	Page 17, Line 23. After the word 'seven' add the words 'unlined and unprotective.' (*Comment received on the initial release PHA dated December 2003.)*	Thank you for your comment. The term "unlined" was added to the referenced sentence in the final PHA.
116	P. 18. Fig. 6 lacks a color legend, especially for the unlabeled blue areas.	Thank you for your comment. The blue shading was removed in the final PHA.
117	P. 19. Line 19. Specify how the waste managed to "travel over the dam."	The wording was changed to the following: "This dam was used as a basin for further settling of the solids that remained…But some waste products did not settle into the 3513 Pond or White Oak Lake; instead, some of the flow spilled over White Oak Dam into the White Oak Creek Embayment and then reached the Clinch River."
118	P. 20. Insert "tags" that identify areas of interest in Fig. 7.	Thank you for your comment. Labels were added to this figure in the final PHA to identify the locations of the Clinch River, X-10/ORNL, the X-10/ORNL disposal area, White Oak Lake, White Oak Creek, White Oak Dam, White Oak Creek Embayment, and the Sediment Retention Dam.
119	Page 20, Table 2. Estimated Discharges (in curies) of Radionuclides from White Oak Creek. Line 9: "The four radionuclides expected to be of most concern are highlighted in gray." Okay, we can't guess what these four	The gray highlighting is apparent in the April 2005 public comment version of the PHA as well as in the final PHA.

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	most important ones are; there is no gray shading on this document. Please identify them specifically. Please prioritize them, along with the route of exposure of most concern. (*Comment received on the initial release PHA dated December 2003.)*	In this public health assessment, ATSDR evaluated radioactive contaminant data for the Clinch River and the Lower Watts Bar Reservoir surface water, sediment, and fish, as well as vegetables, turtles, and local game animals for the Clinch River, to determine whether the levels of radionuclides might pose a past, current, or future public health hazard. Depending on the waterway and time period, the evaluation included the following exposure scenarios: ■ Incidental ingestion of water during recreational activities, ■ Ingestion of river or reservoir water for drinking water, ■ Contact with water during recreational activities, irrigation, or showering, ■ Contact with surface sediment, ■ Contact with dredged sediment used as topsoil in home gardens, ■ Consumption of locally grown milk, meat, or produce, and ■ Consumption of fish, turtles, or local game animals. Section III. Evaluation of Environmental Contamination and Potential Exposure Pathways presents a detailed evaluation of past, current, and future exposure to these radionuclides based on the various exposure scenarios presented above. Please refer to this section of the final PHA for more information.
120	Page 21, Line 18: Table 3. Summary of Peak Annual Releases for the Eight Key Radionuclides. There are more than twenty four radionuclides that have been released to WOC over the years. This fact is documented in the ORHASP (Oak Ridge Health Agreement Steering Panel) Final Report, although they are not cited individually. Citizens can access this complete report themselves at the following website, and ATSDR should include that website at this point in its text: http://www2.state.tn.us/health/CEDS/OakRidge/Oridge.html. All of these radionuclides should be identified here and the 'Eight Key Radionuclides' simply highlighted on the more inclusive list. What are the target organs of concern if citizens have been exposed to these twenty-four contaminants? (*Comment received on the initial release PHA dated December 2003.)*	Page 12 of the Oak Ridge Health Agreement Steering Panel (ORHASP) final report states: "Of the more than two dozen radionuclides that have been released to White Oak Creek over the years, eight were identified as historically most important: cesium 137, iodine 131, strontium 90, cobalt 60, ruthenium 106, niobium 95, zirconium 95, and cerium 144." These are the same eight radionuclides presented in Table 3 of the final PHA that presents a **summary of peak annual releases** from White Oak Dam for the eight key radionuclides. Thus, the table presents a summary of those releases found to be of most concern; it does not present all of the radionuclides released because many of them were not released at levels determined to be of potential concern to the public and therefore do not require in-depth discussion or evaluation. In addition, in Section III.B.2. Past Exposure of the final PHA, ATSDR details the Task 4 of the Tennessee Department of Health's Reports of the Oak Ridge Dose Reconstruction (Task 4 report) screening assessment that involved a phased approach, including a discussion on the target organs, radionuclides of concern, and pathways requiring further evaluation. First, the Task 4 team identified 24 radionuclides released from the X-10 site into the Clinch River from 1944 to 1991 as potential contaminants of concern. These were not the only radionuclides released, but these were the only ones identified as potential contaminants of concern based on the Task 4 team's initial assessment. Through a risk-based screening process, the Task 4 team then calculated conservative human health risk

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		estimates for reference individuals and target organs to further determine the radionuclides and exposure pathways of concern. Eight radionuclides required further evaluation; following a supplemental analysis, four radionuclides were found to be important contributors to dose and health hazards. Please see this section of the final PHA for more information and the Task 4 report at http://www2.state.tn.us/health/CEDS/OakRidge/WOak1.pdf. The ORHASP final report is discussed in detail in Section II.F.2. of the final PHA. The Web site link to the report was added to the paragraph on ORHASP: "For additional information on the ORHASP findings, please see the final report of the ORHASP titled *Releases of Contaminants from Oak Ridge Facilities and Risks to Public Health* at http://www2.state.tn.us/health/CEDS/OakRidge/ORHASP.pdf."
121	P. 22. Terminology describing "earthen pits" (aka LLW seepage pits) and "earth-covered trenches" (aka LLW seepage trenches) should be consistent between text and Fig. 8. The principle of operation of the liquid waste disposal trenches should be described. These trenches operated hydraulically in a manner similar to a septic tank drain field, but with the waste being retained closely downstream rather than upstream, in this case, by virtue of the electrostatically polar nature of the clay and shale particles surrounding the trenches. These particles attracted and held a large fraction of the radioisotopes seeping out of the trenches. The trenches were also originally known as "Intermediate Level" liquid waste disposal trenches. If possible, the percentage of the radioisotopes pumped into the trenches that were retained by the shale and clay should be estimated and stated.	Thank you for your comment. The text was changed as suggested. In the final PHA, it now reads: "In 1960, the 'earthen pit' (also known as a low-level waste [LLW] seepage pit) was changed to an 'earth-covered trench' (also called a LLW seepage trench) to reduce inadvertent radiation exposure and rainwater buildup." Thank you for this suggestion. This text was added verbatim as a footnote to describe the operation of the waste disposal trenches. Please note that the percentage of radioisotopes pumped into and retained in the trenches relates to contamination remaining on site at the reservation. In this public health assessment, ATSDR is only evaluating releases that traveled off site from the ORR.
122	P. 23. It would be instructive to identify the Intermediate Holding Pond and the Wastewater Treatment Process Plant in Fig. 8.	The Intermediate Holding Pond and the Process Waste Treatment Plant have been added to Figure 8 in the final PHA.
123	Page 23, Figure 8. Map of the Bethel Valley Watershed and the Melton Valley Watershed. This diagram does not delineate the boundaries of each respective watershed. Where are the other three watersheds cited in Page 22, Line 29? (*Comment received on the initial release PHA dated December 2003.)*	To facilitate the investigation and remediation of contamination related to the reservation, the contaminated areas on the ORR were separated into five large tracts of land that are typically associated with the major hydrologic watersheds. The contaminated areas associated with X-10 (the only releases evaluated in this PHA were from X-10) are, however, located in the Bethel Valley Watershed and the Melton Valley Watershed. Therefore, only these two watersheds are highlighted on Figure 9 in the final PHA and

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		described in detail in the document. For information on additional watersheds, please refer to the PHA titled *Evaluation of Potential Exposures to Contaminated Off-site Groundwater From the Oak Ridge Reservation (USDOE)* (available at http://www.atsdr.cdc.gov/HAC/PHA/region_4.html#groundwater) for ATSDR's evaluation of off-site groundwater. Copies of this and other ATSDR documents are available from the ATSDR Information Center. You may call the center toll-free at 1-888-422-8737.
124	Page 25. Figure 9. Map of the Major Remedial Activities in Bethel Valley. Where are Core Hole 8 Plume (cited in Page 24, Line 15) and First Creek (cited in Page 26, Line 2) on this map? Where are the MVSTs (Melton Valley Storage Tanks) on this map? Add a legend for all the acronyms for these remedial activities: HFIR, HPFR, TSF, CFRF, and others. Define "grouted." (*Comment received on the initial release PHA dated December 2003.)*	The Corehole 8 plume and First Creek are both identified in the final PHA on Figure 10. Map of the Major Remedial Activities in Bethel Valley. This map, as the title indicates, only presents where major remedial activities are taking place in Bethel Valley. These actions are described in further detail in Appendix B of the final PHA. The Melton Valley Storage Tanks are not depicted on this map because they are not considered part of the major remedial activities occurring in Bethel Valley for a few reasons. These eight approximate 50,000-gallon underground storage tanks (USTs), located in Melton Valley, are used to contain transuranic (TRU) waste from past processes and remedial activities. Thus, these tanks are not currently being remediated, but are being used to contain wastes resulting from on-site remediation activities at the X-10 site. As a clarification, the acronyms mentioned in this comment (HFIR, HPRR [not HPFR], TSF, and CFRF) are not on the map of major remedial activities in Bethel Valley because they are not remedial activities—they are various facilities on the ORR: consolidated fuel recycling facility (CFRF), high flux isotope reactor (HFIR), health physics research reactor (HPRR), and tower shielding facility (TSF). These acronyms, which are presented in the final PHA in Figure 9. Map of the Bethel Valley Watershed and the Melton Valley Watershed, have been defined in the map's legend. The section describing these remedial activities is now presented in Appendix B. The referenced sentence was changed to the following to define the term "grouted:" "The empty tanks were left in place and grouted (i.e., sealing off the flow of contaminants by pumping cement grout or chemicals into drill holes) in 2001; the remedial action report was approved in October 2001."
125	Page 28, Line 28. Which other contaminants? Specifically name them. (*Comment received on the initial release PHA dated December 2003.)*	The following reference was used for this information: ■ Science Applications International Corporation. 2002. 2002 remediation effectiveness report for the US Department of Energy, Oak Ridge Reservation, Oak Ridge, Tennessee. Science Applications International Corporation. US Department of Energy: Office of Environmental Management; March. This document states that "The WOCE TC RmA [White Oak Creek Embayment Time-

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		Critical Removal Action] was initiated in 1991 after site characterization data indicated the embayment was an uncontrolled source of cesium 137 and **other sediment-bound contaminants** to the Clinch River system." No other contaminants are specifically mentioned regarding the "other sediment-bound contaminants." Thus, ATSDR is unable to provide the additional requested information.
126	Page 29, Figure 20. Map of the Major Remedial Activities in Melton Valley. A recurrent omission on most of ATSDR's figures. Please spell out all acronyms used in the figure in a legend: WAG, SEEP, OHF, and others. (*Comment received on the initial release PHA dated December 2003.)*	The acronyms are presented on the figure in the final PHA. Please note, however, that "seep" is not an acronym.
127	Page 30, Figure 11. Completed, Current, and Future Remedial Activities in Melton Valley. Please spell out all acronyms used in the figure in a legend: SWSA, MSRE, OHF, and others. (*Comment received on the initial release PHA dated December 2003.)*	Acronyms are included in this figure (Figure B-1) in the final PHA.
128	Page 35, Line 1. What is "grouting?" (*Comment received on the initial release PHA dated December 2003.)*	"Grouted" was defined previously in the final PHA as "sealing off the flow of contaminants by pumping cement grout or chemicals into drill holes."
129	P. 36. Line 33. "When the government…" (Delete the comma.)	The comment is noted. The text was changed in the final PHA.
130	Page 38, Lines 22-25. Unclear what is trying to be said here — rework this passage. (*Comment received on the initial release PHA dated December 2003.)*	The text was rewritten as the following: "The baseline risk assessment indicated that standards for environmental and human health would not be reached if deep channel sediments with cesium 137 were dredged and placed in a residential area, and if people consumed moderate to high quantities of specific fish that contained increased levels of PCBs."
131	P. 39. Lines 22-26. These are parenthetical statements.	ATSDR contacted an editor regarding this comment. Though these are not truly "parenthetical statements" per say, the sentences are an aside from the preceding text. To address this comment, ATSDR separated these statements from the other text by placing the information in a text box.
132	P. 40. Line 9. In this and in subsequent text, please state clearly to which year these data apply and consistently provide a reference.	Historical census data for Meigs, Rhea, and Roane Counties were obtained from Bureau of the Census 1993: *1990 Census of Population and Housing, Population and Housing Unit Counts, United States*. This might seem out of place as this reference is dated 1993, but it provides county data for 1940, 1950, 1960, 1970, 1980, and 1990. See Table 30 (page 107) of the reference at http://www.census.gov/prod/cen1990/cph2/cph-2-1-1.pdf for more information.

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		Census data for Harriman, Kingston, Rockwood, and Spring City were obtained from census reports for the individual years (i.e., 1940, 1950, 1960, 1970, 1980, 1990, and 2000). The reference was consistently changed to Bureau of the Census.
133	P. 61. Lines 14–17. The statement about providing images in slideshow format in FY 2004 needs updating.	ATSDR contacted DOE to inquire about the status of the Comprehensive Epidemiologic Data Resource (CEDR). According to DOE, CEDR now provides images in slideshow format that give estimated concentrations, doses, and risk values for three contaminants (iodine, mercury, and uranium) in air at locations studied in the Tennessee Department of Health's (TDOH) Oak Ridge Dose Reconstruction. The text was changed to reflect this updated information in the final PHA.
134	P. 66. Line 10. Put Footnote 3 on this page. The footnote should also state whether or not the "new system" still involves "weighting factors."	The comment is noted. The footnote (now footnote 6) was moved to this page in the final PHA and changed to the following: "For 2005, the ICRP is proposing a new system, which still involves weighting factors, that uses cancer incidence and considers lethality rate, years of life lost, and weighted contribution from the nonfatal cancers and hereditary disorders."
135	P. 66. Line 11. Note that the term should be "W_T."	The comment is noted. The text was changed in the final PHA.
136	P. 68. Line 16. Replace the word *decay* with the words *be eliminated*. The sentence would read: "Radionuclides that are taken into the body will also be eliminated by biological processes such as excretion."	The comment is noted. The text was changed in the final PHA.
137	P. 68. Line 25. Delete the sentence containing the words *always less* to avoid confusion when the reader sees rounded values that are the same in Table 7 on page 69.	The comment is noted. The text was changed to: "The effective half-life is always less than *or equal to* either its physical or biological half-life."
138	P. 72. Line. 27. "provides a table of Task 4…."	The comment is noted. The text was changed in the final PHA.
139	P. 77. Lines 14–16. The sentence beginning on line 14 is hard to understand because of its grammar ("Though, because…") and because the phrase, "actively exchanged," is not explained.	The sentence was changed to the following in the final PHA: "Because Clinch River sediments are not as actively exchanged as the river water itself (i.e., the sediments do not mix as much as the surface water), the Cs 137 in sediment at CRM 14 has decreased as a function of its half-life."
140	Page 77, Table 6. Conservative Screening Indices for Radionuclides in the Clinch River. This table is useless for the reader. This information should be parceled out into nine separate tables, according to the nine Exposure Pathways displayed. Each of these separate tables should then be rank ordered according to the decreasing levels of risk for respective	This table was taken directly from Table 3.1 on page 3-10 of Task 4 of the Tennessee Department of Health's Reports of the Oak Ridge Dose Reconstruction (Task 4 report); it was not modified by ATSDR. ATSDR believes that this table, which is in Appendix E of the final PHA, provides a useful summary of the conservative screening indices (or calculated probabilities of developing cancer) for radionuclides in the Clinch River as reported in the

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	radionuclides. Add a tenth table to summarize the preceding nine tables by teasing out only those bold values in the present Table 6 (i.e., only the first eight lines). Please avoid the use of the words 'Conservative Screening Indices.' Stakeholders may misconstrue this as inferring a relationship to the right wing of the Republican party. Instead substitute the words: 'Screening Levels Which are Protective of Public Health' — which should be done through out all your PSAs. Briefly explain to the reader the CERCLA risk range of discretion — 1 x 10^{-4} to 1 x 10^{-6}. Otherwise, how will stakeholders glean from this monstrosity of a table which of these scientific notation numbers are critically important to their public health? For instance, The reader has a fundamental right-to-know that the first line of this table is displaying information to the effect that the Cs-137 contamination of fish in the Clinch River is at a higher level than the CERCLA 'acceptable' risk range above. The EPA risk limits are also exceeded for separate exposure to all of the following: ▪ Sediments along the shoreline ▪ Dredged sediments ▪ Eating beef ▪ Drinking milk ▪ Eating vegetables How are stakeholders supposed to ferret this critical exposure information from this table? To the interested stakeholder, this regurgitation of undecipherable critical exposure information, with exposure levels hidden in the cryptographic hieroglyphics of scientific notation, is not helpful. Stop 'talking down' to stakeholders by providing overly complex tables of important exposure data, which cannot possibly be deciphered by most stakeholders downstream of DOE ORR. Is this purposeful on ATSDR's part — or is this just plain stupid? Interested readers and all downstream stakeholders deserve better. (*Comment received on the initial release PHA dated December 2003.)*	Task 4 report. See Appendix D for a brief on the 1999 Task 4 report. Copies of the Task 4 report are available at the DOE Information Center located at 475 Oak Ridge Turnpike, Oak Ridge, Tennessee (telephone number: 1-865-241-4780) or at http://www2.state.tn.us/health/CEDS/OakRidge/WOak1.pdf. ATSDR finds that creating 10 tables to display the information that is already presented in this one table would complicate the information for the reader. The purpose of this table is to summarize the conservative screening indices from the Task 4 report and indicate those (in bold) that were carried into the next iteration of analysis by the Task 4 team. The Task 4 team's analysis and the radionuclides and pathways that were evaluated in detail are presented in Section III. Evaluation of Environmental Contamination and Potential Exposure Pathways in the final PHA. Anyone who would like additional information is prompted throughout the final PHA to the original source material, but again, the purpose here is to present the information in a concise and user-friendly format. The term "conservative screening indices" was used by the Task 4 team, and thus ATSDR uses the team's terminology when presenting this information and would not feel comfortable changing it. The term is, however, defined in the summary section of the final PHA as "calculated probabilities of developing cancer." Contrary to trying to hide or make information undecipherable, ATSDR is summarizing and providing this complex data in an easy-to-read, user-friendly format. In fact, a commenter at a work group meeting noted, "the document as a whole was easy to read." Please refer to Section III.B.2. Past Exposure (1944–1991), Task 4 Screening Assessment, in the final PHA. This section discusses that the Task 4 team used an upper bound of 1 in 100,000 (1×10^{-5}) as the decision point, or minimal level of concern, during its assessment. This value was one-tenth of the Oak Ridge Health Agreement Steering Panel (ORHASP)-recommended value of 1 in 10,000 (1×10^{-4}); thus, the value used by the Task 4 team was *more conservative* than the ORHASP-recommended value. The remaining text of this section of the PHA explains in user-friendly detail how certain pathways and radionuclides were evaluated and retained for further analysis. Please see this section of the document and refer to the Task 4 report for any additional information.
141	P. 81. Line 29. The definition of the 95% confidence interval needs improvement. The 95% confidence interval is the range of values, centered on the estimated mean, within which there is a 95% probability	The comment is noted. The text was changed in the final PHA based on this suggested wording.

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	that the true mean will actually fall. Note that "95th confidence level" is improper terminology.	
142	P. 82. Line 13. "ATSDR narrowed its evaluation…"	The comment is noted. The text was changed in the final PHA.
143	P. 82. Line 18. Explain "weighting factors," and give examples.	Weighting factors are explained and examples are provided on page 68 of the final PHA. A reference to this table and explanation is now provided in the suggested paragraph of the final PHA.
144	P. 86. Place footnote 8 on this page, not on the following page.	The footnote, now footnote 11, has been placed on the correct page in the final PHA.
145	P. 95. Line 23. Note that "becquerel" is not defined here nor in Appendix A.	Becquerel is defined in Table 8 of the final PHA. The term becquerel was added to Appendix A.
146	Page 102, Table 21. Summary of Public Health Implications From ATSDR's Evaluation of Past and Currently Exposure to Radionuclides Released to the Clinch River/Lower Watts Bar Reservoir. Separate this table into three tables, one for past exposure and one for current exposures. Keep the current exposure all on the same page. Create an additional table which drops all the text in the third column and simply displays columns one, two, and four. Row one of this table states that people sustain greater exposure if they take fish closer to the confluence of WOC and the Clinch. No mention of the range of travel of these 'hot fish' is provided and fish swim around. Fish don't simply stay put. Fish are occasionally 'flushed' out of Watts Bar Reservoir by reservoir drawdowns and power generation events. Certain species in the Clinch, like the Gizzard Shad, migrate from the Ohio River near Paducah, Kentucky, even to locations upstream of DOE ORR, and back downstream. The migratory patterns of the many species are not discussed at all. (*Comment received on the initial release PHA dated December 2003.)*	This table was completely modified during subsequent revisions of the document. In the final PHA, this is broken into two tables: Table 22. Past (1944 to 1991) Radiation Doses for the Area Along the Clinch River and Table 23. Current Radiation Doses for the Lower Watts Bar Reservoir and Clinch River. The third column no longer exists as it was; instead, there are six columns in Table 22 and seven columns in Table 23. The information is now presented in a much more simplified manner so the reader can easily see the estimated doses, comparison values, and whether these doses were above or below the comparison values.
147	Page 109. Except for the first two lines, the lines of text are unnumbered. For what would be Line 11, stakeholders are providing this additional collection of citizen's concerns, which ATSDR may not yet be aware. (*Comment received on the initial release PHA dated December 2003.)*	All of the line numbers were removed in the final PHA. ATSDR appreciates your comments, which are addressed here, as well as all of the concerns provided by residents and other interested parties. All of the concerns received by ATSDR regarding radionuclide releases to the Clinch River and the Lower Watts Bar Reservoir via White Oak Creek are addressed in this final PHA. Community concerns related to other topics are covered in corresponding PHAs.

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148	P. 111. Footnote 11. Shouldn't the word "data" be replaced with the word "survivors?" Also, the reference (Schull 1995) does not appear to be in the reference list.	Thank you for your comments. The table note was changed to the following in the final PHA: "Based on studies of atomic bomb survivors." In addition, the following was added to the reference list in the final PHA: Schull WJ. 1995. Effects of atomic radiation: a half century of studies from Hiroshima and Nagasaki. New York: John Wiley and Sons, Inc.
149	P. 144. Line 10. "Ringworm" is like the word "deer;" it has no plural form ("ringworms"). The word is used correctly in footnotes of page 111, line 12 and on page 112, line 11.	The comment is noted. The text was changed in the final PHA.
150	Appendix A. Undefined terms include "screening index" and "gray."	Thank you for your comment. Both of these terms are defined in Appendix A in the final PHA.
151	Appendix A. ATSDR Glossary of Environmental Health terms, Page A-2, Line 18. Fishers and other stakeholders note that 'bioaccumulation' and 'food chain' are conspicuous by their absence from this glossary. This is important because certain non-radioactive contaminants like mercury, and certain radioactive contaminants like Sr-90 and Cs-137, all three are amplified up the 'food chain' and their effects can be magnified far above what might be expected from their initial release concentrations. Again, it would be helpful if bioaccumulation were to be included in this glossary.	ATSDR provides this glossary to define certain terms that are used throughout the final PHA. "Food chain" was added to and defined in the glossary because the term is used in Section IV. Public Health Implications of the final PHA. Because, however, the term "bioaccumulation" is not used anywhere in the document, it was not added to the glossary.
152	Appendix A. ATSDR Glossary of Environmental Health Terms, Page A-5, Line 41. A definition for "environmental fate" needs to be included as well. Again, it would be helpful if environmental fate were to be included in this glossary. (*Comment received on the initial release PHA dated December 2003.)*	ATSDR provides a glossary in Appendix A of the final PHA to define terms used in the document. The term "environmental fate" was not added to the glossary because it is not used anywhere in the final PHA.
153	Appendix A. ATSDR Glossary of Environmental Health Terms, Page A-12, Line 37. Add a definition of what is meant by "reference man." "Reference man" is cited multiple times throughout this PHA, but not explained. For instance, see Appendix C, Page C-1, Line 26 and Page C-2, Line 24. (*Comment received on the initial release PHA dated December 2003.)*	This appendix, which previously used the term "reference man," was removed during subsequent revisions of the PHA. The term is not included in the final PHA, and therefore it was not added to the glossary in Appendix A.
154	Page B-6. The note that Trenches 5 and 7 are to be remediated by in-situ vitrification (ISV) is out of date. In May 2004, the method of remediation was changed from in-situ vitrification to in-situ grouting. (See the article in the *Knoxville News Sentinel* dated March 15, 2004, and a letter from Mr. David Mosby of the Oak Ridge Site Specific Advisory Board to Mr. Steve	Thank you for your comment. In May 2004, the U.S. Department of Energy (DOE) issued a proposed plan to substitute in situ vitrification with *in situ* grouting. This proposed requirement for the record of decision and the remedial action work plan for *in situ* grouting were approved in September 2004. The acronym has been changed in the figure noted by the commenter (Figure B-2) and the

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	McCracken, DOE-ORO, dated July 15, 2004).	term was changed on Figure B-1. In addition, the following text was added to footnote 17 (which describes in situ vitrification) in the final PHA: "*In situ* vitrification (ISV) is a process that applies electrical power to contaminated soil to produce the heat needed to melt and blend the soil and waste into an immobile form (USDOE 1995b). DOE determined, however, that ISV could be problematic because of standing water in the trenches and higher than anticipated expenses related to the process. Thus, in May 2004, DOE issued a proposed plan to amend the Record of Decision by replacing ISV with *in situ* grouting (ISG). ISG involves a low-pressure grouting method to inject Portland cement-based grout throughout the trenches. In addition, a solution grout would be used to treat soil adjacent to the trench walls to close potential seepage pathways (ORSSAB 2004). In September 2004, the proposed requirement for the Record of Decision and the remedial action work plan for ISG of the trenches were approved."
155	Pp. C-1, Line 16, and C-6, Line 21. Replace "blot clots" with "blood clots."	The comment is noted. The text was changed in the final PHA.
156	Please number the pages of Appendix D.	Page numbers have been added to all of the pages in Appendix D in the final PHA.
157	Appendix D. Implications of Exposure to the Eight Radionuclides Identified for Further Evaluation in the Dose Reconstruction Report, Page D-14, Line 19. State which types of cancer would probably be produced (e.g., soft tissue sarcomas). *(Comment received on the initial release PHA dated December 2003.)*	This appendix was removed during subsequent revisions and is not included in the final PHA.
158	Table E-1. What are the units of "Screening Index?"	The screening indices in this table are presented directly as reported in the Task 4 report titled *Radionuclide Releases to the Clinch River from White Oak Creek on the Oak Ridge Reservation—an Assessment of Historical Quantities Released, Off-site Radiation Doses, and Health Risks*. See Appendix D for a brief on the 1999 Task 4 report. Copies of the Task 4 report are available at the DOE Information Center located at 475 Oak Ridge Turnpike, Oak Ridge, Tennessee (telephone number: 1-865-241-4780) or at http://www2.state.tn.us/health/CEDS/OakRidge/WOak1.pdf. To estimate the screening index, or screening-level risk, the Task 4 team used different equations to represent the various possible exposure pathways. According to the Task 4 report: "These screening values represent conservative estimates of excess lifetime risk of cancer incidence from an exposure duration equal to the number of years of historical releases. The contaminants and pathways with a screening index above 10^{-5} have been analyzed in more detail …" Each equation considered different parameters with varying units. These equations are presented for all of the pathways (drinking water, fish ingestion, external exposure to the shoreline, swimming, external exposure to dredged sediment,

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		ingestion of beef, ingestion of milk, ingestion of vegetables, and irrigation) in Appendix 3A of the Task 4 report at http://www2.state.tn.us/health/CEDS/OakRidge/WOak2.pdf. Though most of the various parameters considered in these screening index equations had units, the screening index is a risk level calculated and compared to the decision point or the minimal level of concern—determined as 1×10^{-5} (also written as one in 100,000) by the Task 4 team. Any screening indices that exceeded the minimal level of concern were carried through the screening evaluation and further analyzed.

Appendix H. Responses to Peer Reviewer Comments on White Oak Creek Radionuclide Releases Public Health Assessment

The Agency for Toxic Substances and Disease Registry (ATSDR) received the following comments from independent peer reviewers for the White Oak Creek Radionuclide Releases at the Oak Ridge Reservation (ORR) Public Health Assessment (PHA) (April 2005). For comments that questioned the validity of statements made in the PHA, ATSDR verified or corrected the statements.

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Does the public health assessment adequately describe the nature and extent of contamination?		
1	It does quite a good job at this. The radionuclides were the appropriate ones to examine, as were the environmental media in which they were determined. The authors have chosen the appropriate locations to characterize the contamination, given the use of the region by the surrounding population.	Thank you for your comment.
2	Yes, it appears that the study carefully considers the local and disseminated levels of contamination of both radionuclide and chemical contaminants. The study further addresses local concerns raised by the residents of the area even when it is doubtful that there is any validity to the concern raised.	Thank you for your comment.
3	To the careful reader it is clear that ATSDR does not generate any contamination level information by direct measurement but rather relies on the information published by others for the ATSDR analysis. This feature of the report should be directly stated in the introductory aspect of the report as the conclusions reached in the report are based on the accuracy of this information.	ATSDR does explain the sources of information used to evaluate past, current, and future exposures in Section I. Summary and Section III. Evaluation of Environmental Contamination and Potential Exposure Pathways of the public health assessment. For past exposures, we state that ATSDR primarily relied on data generated during *Task 4 of the TDOH's Reports of the Oak Ridge Dose Reconstruction: Radionuclide Releases to the Clinch River from White Oak Creek on the Oak Ridge Reservation—an Assessment of Historical Quantities Released, Off-Site Radiation Doses, and Health Risks (referred to as the "Task 4 report")*. For current exposures to the Clinch River and Lower Watts Bar Reservoir, the summary section details how ATSDR uses data collected from 1988 to 1994 as presented in ATSDR's 1996 *Lower Watts Bar Reservoir Health Consultation*. It has been added to the summary section of the PHA that these data include environmental sampling data from the 1980s and 1990s collected and assembled by the U.S. Department of Energy (DOE), the Tennessee Valley Authority (TVA), and various consultants, as well as data from TVA's 1993 and 1994 annual radiological environmental reports for the Watts Bar Nuclear Plant. In addition, the PHA states that ATSDR used data collected from 1989 to the present (2003) in the Oak Ridge Environmental Information System (OREIS). The PHA explains that OREIS falls

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		under DOE ownership, and that OREIS contains data related to compliance, to environmental restoration, and to surveillance activities (including but not limited to studies of the Clinch River embayment and the Lower Watts Bar, as well as annual site summary reports). For future exposures, the PHA states that ATSDR based its evaluation on current exposures and doses related to releases from White Oak Creek, data on current contaminant levels in the Clinch River and Lower Watts Bar Reservoir, institutional controls in place to monitor contaminants in these water bodies, and consideration of the possibility that remedial activities could release radionuclides to White Oak Creek. Further, the data show that because of remedial actions and preventive measures at X-10, because of physical movement of sediments from the area, and because of radiological decay, the radionuclide releases from White Oak Creek have decreased over time, and the concentrations of radionuclides in the water and along the shoreline have decreased as well.
4	Yes! Most emphatically! So many different agencies and very interested and competent individuals have been involved in this process that it would be difficult if not impossible to not perform a complete assessment of the nature and extent of contamination.	Thank you for your comment.
Does the public health assessment adequately describe the existence of potential pathways of human exposure?		
5	Yes, these are the appropriate pathways given the nature of the contamination and the environmental media affected. However, I am not fully comfortable with the way in which selected exposure pathways were dropped from the analysis. The approach taken by the authors (in which the relative contribution from each exposure pathway is determined by a screening assessment, and the pathway is retained only if it is in some upper percentile of the contributions by all pathways) is often taken in risk assessment, and so is valid from that perspective. But the description in the text did not convince me that the SUM of the doses from the rejected pathways was significantly smaller than the SUM of the doses from the retained pathways. I suspect their assumption is valid, and the authors have the results to show that this is the case, and so they should make that point more forcefully. Otherwise, there can be a stream of public complaints that pathways X, Y and Z aren't reflected in the summary dose tables at the end. Page 76 is where the issue of dropping radionuclides, and then dropping pathways, becomes important. I am not suggesting any specific changes here, but the process used seems to me to run the danger of leaving most of the risk within the pool of dropped radionuclides and pathways. If you subdivide the total	The authors of the *Task 4 of the Tennessee Department of Health's Reports of the Oak Ridge Dose Reconstruction (Task 4 report)* used a screening assessment to identify the most important radionuclides and pathways associated with past exposures to X-10 radionuclides released off site to the Clinch River via White Oak Creek. Because the Task 4 team evaluated each radionuclide individually by pathway for its screening analysis, the team compared conservative screening estimates to a minimal screening level of 1×10^{-5}—a factor of ten below the Oak Ridge Heath Agreement Steering Panel's (ORHASP) decision guide value of 1×10^{-4}. Because the screening risk estimates for the swimming and irrigation pathways were below the Task 4 report's minimal risk level for all 24 radionuclides, the Task 4 team was able to eliminate these two exposure pathways (and therefore, consumption of locally grown crops) from further analysis. It is important to note that no swimming is allowed in White Oak Creek and no irrigation water comes from the creek, which is located on site at the reservation where public access is restricted. The Task 4 team determined that swimming in the past primarily occurred in creeks emptying into the Clinch River—not in the river itself—and the

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	exposure enough, you eventually find that no one cell is contributing much. If I were a new reader, I might worry that the contribution of the dropped radionuclides and pathways may in the end be greater than that of the retained pathways. Similar to the comments made on an expansion of the summation of the organ dose hazards previously mentioned, the hazards for 16 radioisotopes are each individually discussed and found to be below the CV for the isotope and thus not subject to further study (page 75). A brief treatment of the fact that the sum of the effects of the 16 are also below any CV would be appropriate.	screening analysis did not identify this as a significant pathway. Also, the Task 4 team found that irrigation was not a relevant exposure pathway for additional analysis because the only documented incidence of river water use was to irrigate a small acreage of peaches. The irrigation scenario produced a screening value below 1 x 10^{-5}. Therefore, any potential exposure occurring via these pathways was determined to be so low that it would not yield doses or risks capable of producing adverse health effects. According to page 3-8 of the Task 4 report, "A value of 10^{-5} was used because each radionuclide was compared to the decision guide independently for each exposure pathway. Using the more conservative decision guide for the screening analysis results in high confidence that the radionuclides assigned low priority for a pathway do not in fact contribute significantly to the overall dose or risk for that pathway." Further, the Task 4 team stated: "If the maximally exposed target individual has a low screening index for a contaminant (i.e., the screening estimate of risk for that contaminant is below the decision guide), then the true but unknown risk to members of the general population is expected to be even lower." In other words, as presented on page 3-1 of the Task 4 report, "Detailed study for contaminants whose presence is clearly below a minimum level of concern is not warranted, as further investigation is expected to show that the risk to any actual individual would have been much less than that calculated during the conservative screening analysis (Thiessen et al. 1996)." In addition, ORHASP—a panel of experts and local citizens—provided technical guidance and community oversight of the Task 4 report. The state of Tennessee also had the Task 4 report externally peer-reviewed prior to its release, and ATSDR had the report evaluated by independent technical reviewers. ATSDR's reviewers agreed that the overall design and the scientific approach of the Task 4 report were appropriate, the results generally quite valid and consistent with earlier studies, and the findings applicable to public health decision-making. Furthermore, ATSDR reviewed the radionuclides and exposure pathways excluded in the Task 4 report and concurred that further evaluation was not necessary. Thus, ATSDR agrees with the findings of the Task 4 report and believes that even if these excluded pathways and radionuclides were summed with those that were retained, the estimated doses and risks would be minimal and still below levels expected to cause adverse health effects.
6	Yes, the potential pathways are carefully addressed and such minor ones as the geese feeding in the river habitat, migrating to another area, and subsequently being shot by a hunter and eaten are shown to be of negligible consequence.	Thank you for your comment.

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7	The treatment of the variation of the pathways importance with time such as the pumping of the corehole #8 plume and the benefit of radioactive decay is not directly treated. A resident of the area who is a casual reader might draw some solace from a conservative discussion of these ameliorating factors even though they are in the predicted doses for future exposures.	In this public health assessment, ATSDR evaluated radioactive contaminant data for White Oak Creek releases that enter the Clinch River and travel downstream to the Lower Watts Bar Reservoir. To be clear, this public health assessment only evaluated X-10 radionuclides in White Oak Creek after the surface water was released off site. We recognize that oftentimes contaminants released into surface water may originate from contaminated groundwater, including on-site seeps and other sources of groundwater contamination such as the corehole 8 plume. These potential exposures to off-site groundwater associated with the Oak Ridge Reservation were, however, addressed in another public health assessment entitled *Evaluation of Potential Exposures to Contaminated Off-site Groundwater From the Oak Ridge Reservation (USDOE).* This groundwater PHA addresses issues including plumes, contaminants flowing from groundwater, underlying aquifers, and other topics as well. Copies of this and other ATSDR documents are available from the ATSDR Information Center. You may call the center toll-free at 1-888-422-8737 or view the document online at http://www.atsdr.cdc.gov/HAC/PHA/region_4.html#groundwater. In Section III. Evaluation of Environmental Contamination and Potential Exposure Pathways of the PHA, ATSDR states that because of remedial actions and preventive measures at X-10, physical movement of sediments from the area, and *radiological decay*, the radionuclide releases from White Oak Creek have decreased over time and the concentrations of radionuclides in the water and along the shoreline have decreased as well. Similar text has also been added to the I. Summary and IV. Public Health Implications sections of the document, and the term *radioactive decay* has been added to the glossary in Appendix A of the final PHA.
8	The non-disturbance of the sediment is a critical factor in the calculations of future exposures to both chemical and radioactive materials. This is recognized by the agencies involved and stated in the report but it might be emphasized more strongly. It appears to be the most significant factor in the assumptions made on future exposures to the carcinogens.	ATSDR agrees that the nondisturbance of sediment is a critical factor in considering potential future exposures to radionuclides in the Lower Watts Bar Reservoir and the Clinch River. For this reason, nondisturbance of sediment is discussed throughout the document in Sections II.C. Remedial and Regulatory History, II.F. Summary of Public Health Activities Pertaining to White Oak Creek Radionuclide Releases, III.B.3. Current and Future Exposure, and VIII. Conclusions. These sections provide information on the institutional controls in place to prevent disruption of sediment, ATSDR's evaluation of DOE's remedial measures to keep contaminated deep channel sediment in place, and ATSDR's current and future evaluation of potential exposures to sediment in the Lower Watts Bar Reservoir and the Clinch River. Also, please refer to the brief in Appendix D of the final PHA on ATSDR's *Lower Watts Bar Reservoir Health Consultation*, which evaluated DOE's remedial decisions for the reservoir

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		including leaving contaminated deep channel sediment in place. In the health consultation, ATSDR concluded: "Current levels of chemical and radioactive contaminants in the reservoir sediment do not and will not pose a public health problem. For the sake of caution and to prevent unnecessary exposure to workers and the public, sediment should not be disturbed without thorough review of sediment sampling data in the specific area where sediment-disturbing activities will take place."
9	From the radiological viewpoint or my area of competence, it does a very good job of describing the existence of potential pathways of human exposure. I would call this one of the strong points of the report. I believe that it has also done a good job on chemicals but I am not competent to judge that.	Thank you for your comment.
Are all relevant environmental and toxicological data (i.e., hazard identification, exposure assessment) being appropriately used?		
10	Very few data make an appearance in the document. Most results appear to be from modeling. This is in part surprising for the exposure assessment, as there is a strong dataset for at least some of the geographic locations considered. There is an attempt to at least display some of the data in Figure 21, but no mention is made of the degree of fit between data and models, and whether this supports confidence in the models. I do think the authors could have done a better job of showing how well model results on contamination agree with available monitoring data, as there are quite a few datasets available.	For evaluating past exposures to X-10 radionuclides released off site to the Clinch River via White Oak Creek, ATSDR primarily relied on data generated during *Task 4 of the TDOH's Reports of the Oak Ridge Dose Reconstruction: Radionuclide Releases to the Clinch River from White Oak Creek on the Oak Ridge Reservation—an Assessment of Historical Quantities Released, Off-Site Radiation Doses, and Health Risks (referred to as the "Task 4 report")*. Because historical records were not maintained to today's standards, the Task 4 team performed independent reviews of environmental monitoring reports and existing data on releases and also used mathematical models to estimate the radiation doses and the associated risks. According to the Task 4 report, accurate environmental monitoring and sampling data **were not available** to evaluate thoroughly past exposures for X-10 radionuclides released to the Clinch River. Therefore, the Task 4 team performed an in-depth evaluation to estimate the amount of radionuclides that flowed from X-10, over White Oak Dam, and into the Clinch River. Through this evaluation the team derived annual estimates for the eight radionuclides of interest: Co 60, Sr 90, Nb 95, Ru 106, Zr 95, I 131, Cs 137, and Ce 144. Using this information, the team then performed mathematical modeling to estimate the annual average concentrations of the eight radionuclides in water and sediment at specified locations downstream of White Oak Creek. According to the Task 4 report and one of its authors, when available, the Task 4 team used actual measurements in Clinch River water collected at CRM 14.5 (K-25/Grassy Creek) and 4.5 (Kingston Steam Plant) from 1960–1990 to calculate doses for Cs 137, Sr 90, Ru 106, and Co 60. The Task 4 team used modeling to

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		estimate the historical radionuclide concentrations in Clinch River water for the remaining radionuclides and for time periods when data were unavailable. Limited available monitoring data were used to calibrate the results of the team's modeling efforts. Limited information on the Task 4 team's efforts to estimate annual average radionuclide concentrations in Clinch River water and shoreline sediments with the HEC-6-R model is presented in Section 6 of the Task 4 report (available at http://www2.state.tn.us/health/CEDS/OakRidge/WOak1.pdf). The HEC-6-R model, developed by the Hydrologic Engineering Center at the U.S. Army Corps of Engineers, can be used for: a) water surface and energy profile simulation, b) sediment scour and deposition modeling, c) sediment transport modeling, and d) river geometry simulation. For more information on the model, a fact sheet is available at http://www.epa.gov/ORD/NRMRL/pubs/600r05149/600r05149hec6.pdf and the model program files are available for free downloading at http://www.hec.usace.army.mil/software/legacysoftware/hec6/hec6-documentation.htm. Similar concerns were also mentioned by ATSDR's technical peer reviewers regarding the Task 4 report. One reviewer stated, "The report does not present any statistically sound comparisons for the measured and modeled concentrations." Another reviewer stated, "The report does not provide sufficient details to allow calculations and model estimates to be duplicated and verified. In my opinion, this is the primary weakness of the report." In response, one of the authors of the Task 4 report stated, "We agree, more documentation of the models and coefficients used for sediment and water transport are needed and presently missing from the Task 4 report. This section of the Task 4 report could be improved. The detailed documentation of the HEC-6-R sediment and water transport code resides with ChemRisk." The Task 4 report states that the modeled and measured values were comparable in many cases, but that the concentrations based on measurements generally reflected a higher degree of confidence (lower uncertainty) than the modeled concentrations. ATSDR understands and recognizes that insufficient details are provided on the modeling efforts used in the Task 4 report. Nonetheless, a panel of technical experts convened to evaluate the study design, the scientific approaches, the methodologies, and the conclusions of the Task 4 report commented that the results were generally quite valid, consistent with earlier studies, and applicable to public health decision-making as long as careful attention was given to the

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		assumptions behind the estimates. The reviewers agreed that the overall design and scientific approach were appropriate. Therefore, ATSDR believes that the findings of the Task 4 report are appropriate for evaluating past exposures to X-10 radionuclide releases to the Clinch River via White Oak Creek and for making public health decisions regarding these past exposures.
11	On page 95, bone samples appear to be included as part of the Sr90 concentrations in catfish. Why is this done? Sr90 accumulates in bone, but do people really eat the bones? This does not seem to have been assumed for other fish.	According to DOE officials and the *Task 4 of the Tennessee Department of Health's Reports of the Oak Ridge Dose Reconstruction (Task 4 report)*, research and anecdotal information suggest that people living in the Oak Ridge area have consumed fish patties comprised of ground fish, consisting of fish bones and fish flesh. When preparing the health consultation in 1995, limited data describing radionuclide concentrations in fish from the Lower Watts Bar Reservoir were available for ATSDR's review. The available data came from three sites along or downstream of the reservoir: Mid Watts Bar Reservoir (Tennessee River Mile 557.0), the Lower Watts Bar Reservoir north of the Watts Bar Dam (Tennessee River Mile 530.5), and the Upper Chickamaugua Reservoir (Tennessee River Mile 518.0 and below Watts Bar Dam). A combined total of 42 fish specimens were collected, coming from three different species—channel catfish, bluegill sunfish, and largemouth bass. All of the fish fillet samples were analyzed for cesium 137 and cobalt 60. Channel catfish samples were also sampled and analyzed for strontium 90. Because strontium is a bone-seeking radionuclide, higher concentrations of strontium 90 appear in whole fish rather than in fish flesh alone (see Section 8 of the Task 4 report). Thus, ATSDR evaluated consumption of channel catfish with bones since these strontium 90 data were available. ATSDR used a worst-case scenario using the maximum concentration and assuming that adults and children consumed two 8-ounce fish meals a week and that the meal could include some bone. ATSDR concluded that the level of potential radiological exposure from these radioactive contaminants in reservoir fish posed no public health hazard.
12	On page 105, it is mentioned that some geese had high measured concentrations, but then it seems these higher concentrations were not used in calculations because the authors believe it is unlikely a hunter would catch one of them. This may be the opinion of Blaylock (2004), but I don't see why this opinion is valid. How "likely" is "unlikely"?	ATSDR included information from this source (Blaylock 2004) in the text of the PHA only to provide background information on goose consumption for the reader. These comments neither affected nor influenced how ATSDR selected the radionuclide concentrations for estimating exposure doses via goose consumption. To evaluate the current exposures and doses for goose ingestion, ATSDR used data from the Oak Ridge Environmental Information System (OREIS), detailed in Section II.F.4 of the final PHA. The data received and

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		analyzed for geese covered the time period from 1989 to the present (2003). To estimate the radiation doses from ingestion of geese, ATSDR used the average radionuclide concentrations from OREIS to obtain realistic doses to the bone surface, lower large intestine, and whole body (the estimated radiation doses are presented in Table 20 of the final PHA). The highest committed effective dose to the whole body from goose consumption was 14 mrem to a 10-year-old child based on a 60-year exposure—over 355 times less than ATSDR's radiogenic cancer comparison value of 5,000 mrem over 70 years.
13	The reader is dependent on the author to present all of the existing toxicological environmental data for the area. It appears that this is the case as data from both state, federal regulatory, and laboratory sources are quoted and used in the report. The authors are to be complimented on presenting the information in a clear format that is both readable by the non-scientific resident of the area and the radiation protection community. The methods of radiological hazard estimation used in the report appear to follow the "best practice" calculational techniques in existence at this time.	Thank you for your comments.
14	The relative weighting of the radiological vs. chemical hazards has not been made and this is probably prudent as the risk levels associated with each are open to much interpretation.	This public health assessment evaluates off-site exposure to radionuclide releases from X-10 via the Clinch River and Lower Watts Bar Reservoir. Because no chemical exposures are evaluated in this public health assessment, weighing radiological versus chemical hazards is not applicable. The radioactive materials released from White Oak Creek are chemical in nature, and in most cases, heavy metals. The potential health effects resulting from their intake are driven by their radiological properties, however, not their chemical properties. Hypothetically, if an individual had an intake sufficient to result in heavy metal toxicity, the radiation levels would be sufficient to result in adverse health effects. Adverse effects from radiation could occur following exposure to levels well below those required to result in heavy metal poisoning; natural uranium, however, is the only radioactive material where this does not apply. Therefore, as a conservative (protective) measure, ATSDR sets its minimal risk level (MRL) values for radioactive elements (other than uranium) on their radiological properties, not on their chemical properties.
15	As I understand the situation, I believe that all relevant environmental and toxicological data have been appropriately used.	Thank you for your comment.

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Does the public health assessment accurately and clearly communicate the health threat posed by the site?		
16	Yes, it does a very good job of this, conditional on the analysis in the report. There is a good summary of the doses received, and a comparison of these against dose limits selected by the authors. Further, the dose limits selected are appropriate.	Thank you for your comments.
17	I do disagree with the claim by the authors throughout that staying below such limits precludes adverse health effects. They seem to be assuming a threshold model as is typical in non-cancer effects. Such a model has not been recommended by the ICRP or the NCRP, and so is inappropriate here. The wording needs to be changed to refer to a risk that is below unacceptable levels. This will pose a bit of a challenge because the dose limit proposed is on the order of 5,000 mrem over a lifetime. Using the ICRP risk coefficient, which is now close to 5 E-4 per rem, 5,000 mrem (or 5 rem) would produce a lifetime excess probability of cancer of 2.5 E-3. This is well above what is normally considered an acceptable lifetime risk for chemicals. It is inherent in the dose limits, and I don't expect ATSDR to change the regulations, but it does point to a potential public health controversy, and the authors might need to find some wording to convey this.	ATSDR uses the public health assessment process to evaluate the public health implications of exposure to environmental contamination and to identify the appropriate public health actions for particular communities. ATSDR health physicists conduct a health effects evaluation by carefully examining site-specific exposure conditions about actual or likely exposures; conducting a critical review of available radiological, medical, and epidemiologic information to ascertain the substance-specific toxicity characteristics (levels of significant human exposure); and comparing an estimate of radiological dose people might frequently encounter at a site to situations associated with disease and injury. This health effects evaluation involves a balanced review and integration of site-related environmental data, site-specific exposure factors, and toxicological, radiological, epidemiologic, medical, and health outcome data to help determine whether exposure to contaminant levels might result in harmful effects. The goal of the health effects evaluation is to decide whether harmful effects might be possible in the exposed population by weighing the scientific evidence and by keeping site-specific doses in perspective. The output is a qualitative description of whether doses are of sufficient nature and magnitude to trigger a public health action to limit, eliminate, or study further any potential harmful exposures. The PHA report presents conclusions about the actual existence and level of the health threat (if any) posed by a site. It also recommends ways to stop or reduce exposures. For detailed information on risk, please see Appendix F in the final PHA. This appendix, which is not normally included in ATSDR's public health assessments, was added to this PHA because of public requests for risk information. It is important to note that ATSDR does not base its public health conclusions on these risk numbers; they are included in this PHA to provide detailed information on risk for the community. Risk assessments conducted by the U.S. Environmental Protection Agency (EPA) are useful in determining safe regulatory limits and prioritizing sites for cleanup. These risk assessments provide estimates of theoretical risk from possible current or future exposures and consider all contaminated media regardless of whether exposures are occurring or are likely to occur. These quantitative risk estimates are not intended, however, to predict the incidence of disease or measure the actual health effects in people resulting from hazardous substances at a site. By

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		design, these risk estimates are conservative predictions that generally overestimate risk. Risk assessments do not provide a perspective on what the risk estimates mean in the context of the site community and do not measure the actual health effects that hazardous substances have on people. There are subtle differences in ATSDR's process of evaluating chemicals and radiation such as dose to individual organs, age-specific dose coefficients, and other metabolic differences as discussed in several publications from the International Commission on Radiological Protection (ICRP). It is of interest to note that the National Council on Radiation Protection and Measurements (NCRP) in 1989 released a report titled: *Comparative Carcinogenicity of Ionizing Radiation and Chemicals*, NCRP Report 96. In its conclusion, the NCRP stated that fewer than 30 chemicals were known to be cancer-inducing in humans and of those, in most it was not possible to define a dose-incidence relationship except generally. Also, there is much uncertainty in chemical metabolism, in the possibility of additive or synergistic effects between or among chemicals, in the potency of chemicals, and in the dosimetry of chemicals than there is in radiation evaluations. The NCRP stated that risk assessment for chemicals is "generally more uncertain than risk assessments for radiation." Because of these statements by the NCRP, ATSDR does not, in the true sense of the comment, evaluate radiation in the similar manner as the agency evaluates chemicals. ATSDR recognizes that every radiation dose, action, or activity may have an associated risk. In this public health assessment, ATSDR compares annual doses to the 100 mrem/year dose limit of the ICRP, NCRP, and U.S. Nuclear Regulatory Commission (NRC), as well as ATSDR's MRL. ATSDR compares lifetime doses to the agency's radiogenic cancer comparison value of 5,000 mrem over 70 years, which is based on peer-reviewed literature and other documents developed to review the health effects of ionizing radiation. These values, used as screening tools during the public health assessment process, are levels below which adverse health effects are not expected to occur. If the screening indicates that past or current doses exceed our comparison values, then we would conduct further in-depth health evaluation. When ATSDR developed its screening values for radiation exposures, safety margins were incorporated. The approach ATSDR uses to derive MRLs, such as those in the Toxicological Profile for Ionizing Radiation, was developed with the EPA. MRLs for radiation are estimates of daily human exposure to an amount of radiation that is likely to be without appreciable risk of adverse noncancer health effects. MRLs are screening tools used by public health professionals to

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		determine which exposure situations require further evaluation. The chronic MRL for ionizing radiation is 100 mrem/year, which is consistent with the dose limits recommended for the public by the ICRP, NCRP, and NRC. The ATSDR MRL for ionizing radiation is based on numerous evaluations of health effects from exposures to background and occupational levels of radiation. The Ionizing Radiation Toxicological Profile states: "The annual dose of 3.6 mSv [360 mrem] per year has not been associated with adverse health effects or increases in the incidences of any type of cancers in humans or other animals" (ATSDR 1999b). The MRL was derived by reducing the 360 mrem/year by a factor of three to account for human variability (and conservatively rounded down from 120 mrem/year to 100 mrem/year) to be protective of human health. Although the MRL is for noncancerous health effects, when deriving the MRL, no studies were identified that did not result in cancer as the specific end point. Furthermore, the ATSDR legislative authority, as discussed many times, limits ATSDR to evaluating exposures based on observable and tolerable adverse health effects. If adverse health effects are not observed in an epidemiological study, then the doses used in the study should be considered tolerable. Contrary to this reviewer's comment, ATSDR's radiogenic comparison value of 5,000 millirem over 70 years incorporates the linear no-threshold (LNT) model for evaluating public health hazards associated with exposure to radiation. It assumes a total lifetime dose (70 years of exposure) above background that is considered safe in terms of cancer induction. In addition to the LNT model, ATSDR also incorporates a margin-of-dose (MOD) approach into this comparison value. During an evaluation, if ATSDR determines that further investigation is needed, we review scientific literature associated with radiological doses and dose estimates particularly related to adverse health effects. ATSDR then compares the dose estimates from scientific literature to site-specific dose estimates. Thus, ATSDR uses the LNT model to determine when a more detailed site-specific evaluation is necessary and uses the MOD approach to develop realistic information for communities regarding what is known and unknown about radiation levels at a particular site. An independent expert panel convened to review ATSDR's site-specific approaches used to evaluate past, current, and future radiation risks to communities surrounding the Oak Ridge Reservation concluded that this combination of approaches (LNT and MOD) is appropriate for ATSDR to use to determine radiation levels at which health effects actually occur. The panel found that ATSDR's use of the MRL of 100 millirem per year and radiogenic cancer

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		comparison value of 5,000 millirem over 70 years were appropriate screening values. If extrapolated over 70 years assuming constant exposure, the radiogenic cancer comparison value dose estimate would be about 71 millirem per year—a level the panel determined to be very protective of public health in terms of cancer and noncancer risks. The panel also concluded that ATSDR's approach considers evidence for both individual organs and whole-body doses (effective doses), noting that a whole-body dose could not be developed without accounting for doses to single organs. Further, the panel determined that ATSDR's method of distinguishing dose levels from risk levels was acceptable; when calculating doses, ATSDR incorporated risk and LNT explicitly and implicitly. Given our evaluation in this public health assessment, ATSDR concludes that exposures to X-10 radionuclides released from White Oak Creek to the Clinch River and to the Lower Watts Bar Reservoir are not a health hazard. Past and current exposures are below levels associated with adverse health effects and regulatory limits. Adults or children who have used, or might continue to use, the waterways for recreation, food, or drinking water are not expected to have adverse health impacts due to exposure. ATSDR has categorized these exposure situations as posing *no apparent public health hazard*. ATSDR uses this category in situations in which human exposure to contaminated media might be occurring, might have occurred in the past, or might occur in the future, but where the exposure is not expected to cause any harmful health effects. Therefore, we are conveying to the public that radiation exposure is possible, but that this exposure is not expected to result in observable and tolerable health effects.
18	The report is well written and well referenced so the reader can go to the source document for any studies concerning the measurement of the levels of contamination reported.	Thank you for your comment.
19	With the exception of the committed effective whole body doses, the hazard level of each isotope/toxic compound is calculated separately and compared to the ATSDR CV. The casual reader might appreciate some expansion of the CEDE discussion which emphasizes that it is indeed the summation of the individual dose hazards which are listed below it in the tables.	Thank you for your comment. On page 67 of the final PHA the committed effective dose is defined as ICRP's term for the sum of the products of 1) the weighting factors applicable to each body organ or tissue that is irradiated and 2) the committed equivalent dose to the appropriate organ or tissue integrated over time (in years) following the intake, with the assumption that the entire dose is delivered in the first year following the intake. The integrated time for an adult is 50 years; for children, it is from the time of intake to 70 years. The committed effective dose is used in radiation safety because it implicitly includes the relative carcinogenic sensitivity of the various tissues.

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20	Yes. This has been described in detail by comparison with known hazards and the doses causing these known hazards.	Thank you for your comment.
Are the conclusions and recommendations appropriate in view of the site's condition as described in the public health assessment?		
21	The authors have done a nice job of summarizing and justifying their conclusion.	Thank you for your comment.
22	Based on the information presented, the conclusions and recommendations appear to be fully warranted.	Thank you for your comment.
23	The continued need for public information/education could be stressed more.	Throughout our involvement in public health activities associated with the Oak Ridge Reservation, ATSDR has promoted and been involved in outreach efforts to educate the community on various topics. In its 1996 health consultation of the Lower Watts Bar Reservoir, ATSDR recommended working with the state of Tennessee to implement a community health education program on the Lower Watts Bar fish advisory and on the health effects of PCB exposure. As a follow-up to the recommendations in the *Lower Watts Bar Reservoir Health Consultation*, ATSDR created a program to educate the community and physicians on PCBs in the Watts Bar Reservoir. On September 11, 1996, Daniel Hryhorczuk, MD, MPH, ABMT, from the Great Lakes Center at the University of Illinois at Chicago, presented information on the health risks related to the consumption of PCBs in fish. Dr. Hryhorczuk made his presentation to about 40 area residents at the community health education meeting in Spring City, Tennessee. In addition, on September 12, 1996, an educational meeting for health care providers in the Watts Bar Reservoir area was held at the Methodist Medical Center in Oak Ridge, Tennessee. Furthermore, ATSDR collaborated with local residents, associations, and state officials to create a brochure informing the public about the Tennessee Department of Environment and Conservation's (TDEC) fish consumption advisories for the Watts Bar Reservoir. The Tennessee Wildlife Resources Agency (TWRA) also has an information and education department (see http://www.state.tn.us/twra/infoed.html) that distributes information to the public. In addition, ATSDR has held many educational workshops and presentations in the community on topics such as iodine and radiation. ATSDR has also created numerous fact sheets for the community to convey the findings of our public health assessments and other studies. Further, particular to this public health assessment on White Oak Creek Radionuclide Releases, ATSDR is presenting the document and its findings to the public and to health officials, creating a video to communicate the findings of this public health assessment to the public, and distributing fact sheets to communicate the PHA's conclusions. In addition,

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		ATSDR has a Web site solely dedicated to public health activities associated with the Oak Ridge Reservation (available at http://www.atsdr.cdc.gov/HAC/oakridge/).
24	Information such as the results of the quarterly water testing should be publicized and historical results shown so the general population can see the trends in the measurements.	TDEC–DOE Oversight Division publishes its environmental monitoring results in an annual report to the public, including the results of radiological water monitoring. For example, the Annual Report to the Public for 2004 provides findings of radiological water testing dating from 1996 to 2004. These reports are available on line at http://www.state.tn.us/environment/doeo/active.shtml and this link has been added to the public health assessment where appropriate. Copies of the report are also available from the TDEC–DOE Oversight office at 865-481-0995 and the Local Oversight Committee (LOC) office at 865-483-1333. In addition, copies of the reports are available for review at the DOE Reading Room (PD-01816), Information Resource Center, and public libraries located in Kingston, Oak Ridge, Clinton, Knoxville, Meigs County, Loudon County, Dayton, and Wartburg, Tennessee.
25	This reviewer was not impressed with the PCB warning being placed on the Tennessee fishing license material. It appears to be an ineffective way to get the message across. Bolder and more pointed methods should be used to get this message across.	ATSDR developed a brochure on the Tennessee Department of Environment and Conservation (TDEC) fish consumption advisories for the Watts Bar Reservoir. The brochure was the result of the collaborative effort of local citizens, organizations, and state officials. See Appendix D for a brief of the exposure investigation and Section II.F.1. for ATSDR's public health activities related to White Oak Creek radionuclide releases. TDEC's Division of Water Control is responsible for issuing and posting fish advisories. Evaluating fish tissue problems in the state of Tennessee involves a multi-agency effort, comprised of DOE, EPA, TDEC, the Tennessee Wildlife Resources Agency (TWRA), and the Tennessee Valley Authority (TVA). The state fish advisories are available at http://www.state.tn.us/twra/fish/contaminants.html and the current fishing regulations are available at http://www.state.tn.us/twra/fish/fishmain.html. Though PCBs are not within the scope of this public health assessment that focuses solely on radionuclide releases to the Clinch River and Lower Watts Bar Reservoir, ATSDR is preparing a public health assessment that will evaluate PCB releases from the three main ORR facilities: X-10, Y-12, and K-25. When available, copies of ATSDR's public health assessment on PCBs can be obtained by contacting ATSDR's Information Center toll-free at 1-888-422-8737.
26	Yes. I believe they have arrived at a well thought out position supported by a lot of measurements and considerable epidemiological data.	Thank you for your comment.

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Are there any other comments about the public health assessment that you would like to make?		
27	Nowhere in the document does the assessment consider a subsistence fisher, which the EPA often considers. I am not suggesting one, but it may be a point of contention. I assume the upper bound consumption rate considered is to be an approximation to this susceptible subpopulation.	To evaluate past, current, and future exposures to radionuclides in Clinch River and Lower Watts Bar Reservoir fish, higher than average fish consumers were evaluated (detailed below). In its Exposure Factors Handbook (available at http://www.epa.gov/ncea/pdfs/efh/front.pdf) that outlines factors commonly used in exposure assessments, EPA recommends for fish consumption using an assumed average intake rate for the general population of 20.1 grams/day (140.7 grams/week) of total fish. Of this fish intake rate, however, only 6.0 grams/day (42 grams/week) is considered as an average intake rate for the general population consuming freshwater and estuarine fish. All of the exposure assumptions used by ATSDR for past, current, and future exposures to radionuclides in Clinch River and Lower Watts Bar Reservoir fish were at least five times **more than** this average intake for the general population eating freshwater and estuarine fish. As detailed below, even when evaluating fish consumption by using assumed intake rates significantly above these recommended assumptions, ATSDR's estimated doses for past, current, and future exposures were below health-based comparison values. In the *Task 4 of the Tennessee Department of Health's Reports of the Oak Ridge Dose Reconstruction (Task 4 report)*, past exposures to radionuclides in Clinch River fish were evaluated for high fish consumers. Reportedly, a maximum fish consumer in the east south central region of the country would eat about 2.4 fish meals per week (based on a 200 gram per meal fish portion) (Rupp et al. 1980. Age dependent values of dietary intake for assessing human exposures to environmental pollutants. Health Physics 39:151-163. Cited in the Task 4 report). The Task 4 report evaluated high fish consumers, who were referred to as "Category I fish consumers" and were described as individuals who frequently ate fish (between 1 and 2.5 fish meals per week). ATSDR summarized the Task 4 organ doses for the bone, lower large intestine, red bone marrow, breast, and skin locations using the 50th percentile value of the 95% confidence interval. The 50th percentile (central) values represent the medians of organ doses. The highest radiation doses were associated with eating fish taken from the Clinch River near Jones Island between 1944 and 1991. Doses were much lower for all other pathways (see Table 11 and Table 12 in the final PHA). The Task 4 report's estimated organ doses to the bone, lower large intestine, red bone marrow, breast, and skin from eating fish were at least six times greater than the radiation doses to these organs from ingesting meat and milk, drinking water, and via external radiation (see Table 12 in the final PHA). Likewise, ATSDR's derived annual whole-body and committed equivalent doses

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		from eating fish were at least 10 times more than any of the other exposure pathways (see Table 11 in the final PHA). As mentioned and shown in Table 11, radiation doses from eating fish were highest near Jones Island—these annual whole-body and lifetime (70-year) doses were more than eight times greater than for people consuming fish from the Clinch River farther downstream near Kingston. The annual whole-body dose was 3.4 mrem/year for an individual ingesting fish near Jones Island—more than 29 times less than the 100 mrem/year recommended dose limit for the public by the NCRP, ICRP, and NRC. The whole-body lifetime dose for an individual ingesting fish caught near Jones Island was 238.6 mrem over 70 years, which is more than 20 times less than ATSDR's radiogenic cancer comparison value of 5,000 mrem over 70 years. To evaluate current and future exposures to radionuclides in Lower Watts Bar Reservoir fish, this public health assessment used data from ATSDR's *Lower Watts Bar Reservoir Health Consultation*. The health consultation used worst-case scenarios to evaluate radiological exposure to fish, assuming adults and children consumed two 8-ounce fish meals per week (454 grams/week). Even using these conservative assumptions, the estimated dose was 6 mrem per year or less than 420 mrem over 70 years for the committed effective dose. The annual whole-body dose of 6 mrem per year is more than 16 times less than the dose of 100 mrem/year recommended for the public by the NCRP, ICRP, and NRC. The committed effective dose of 420 mrem over 70 years is more than 11 times less than ATSDR's radiogenic cancer comparison value of 5,000 mrem over 70 years. To evaluate current and future exposures to radionuclides in Clinch River fish, ATSDR assumed a child ate 4 ounces of fish per week (113.4 grams/week) and an adult ate 8 ounces of fish per week (227 grams/week). The highest estimated whole-body dose of 89.3 mrem was calculated for an adult based on a 50-year intake to age 70—less than 55 times below ATSDR's radiogenic cancer comparison value of 5,000 mrem over 70 years.
28	Around page 45, there is information provided on populations. However, this information is never used, or even relevant, given the later focus on exposure scenarios and individual risk. It is not clear why the information is provided.	The White Oak Creek study area evaluated in this public health assessment consists of the area along the Clinch River from the Melton Hill Dam to the Watts Bar Dam. All ATSDR public health assessments regularly include demographic information. Such information helps to identify and define the size, characteristics, locations (distance and direction), and possible susceptibility of known populations related to the site and study area. Demographic data provide information on potentially exposed populations and can provide important information for determining site-specific exposure pathways. The information presented in this section is for the largest communities located within the study area (Harriman,

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		Kingston, Rockwood, and Spring City) that could potentially be exposed to radiological contamination in the Clinch River and Lower Watts Bar Reservoir. For more information on ATSDR's public health assessments, please see our *Public Health Assessment Guidance Manual* online at http://www.atsdr.cdc.gov/HAC/PHAManual/toc.html.
29	On page 64, line 22, the statement is made that the doses are higher than the levels to which people are really exposed. I think you should say "the levels to which the majority of people are exposed." The point of using an upper-bound, conservative, procedure is that it captures a plausible upper bound, not that it creates a fictitious dose. If the latter is implied, that will cause controversy.	Thank you for your comment. The change was incorporated into the final public health assessment.
30	On page 66, the description of weighting factors is poor. It needs to be re-written. I am not convinced the authors understand this concept, given the description they provide.	Thank you for your comment. On page 68 of the final PHA, ATSDR not only defines weighting factors but presents a user-friendly table detailing the currently adopted weighting factors by tissue. The term *weighting factors* (W_T) is defined as modifying factors selected for the type of radiation and its energy as it impacts matter to convert organ or tissue dose equivalents to committed effective dose equivalents for the whole body. They are used because the same radiation exposure to different parts of the body can have very different results. That is, if the entire body were irradiated, some parts of the body would react more dramatically than other parts. To take this effect into account, the ICRP developed weighting factors for a number of organs and tissues that most significantly contribute to the overall biological damage to the body. The tissue weighting factors are based on both cancer fatality risk and the relative effect of an exposure to a single organ or tissue. The grouping of tissues is complex, and substantial rounding of the values takes place. When summed for the entire body, the values of W_T are normalized to give a total of one.
31	The figure on page 74 caused me to wonder whether exposures to aerosolized radionuclides hitting a skier might be important. I doubt they are, but the figure does raise the issue.	Thank you for your comment. This possible exposure was implicitly evaluated in the intake of Lower Watts Bar Reservoir and Clinch River surface water by recreational users.
32	Page 81 seems to raise an issue of variability and uncertainty analysis, but I cannot follow how these analyses were done. Distributions are mentioned, and said to be related to "individual sets of measured data," but no detail is provided on this. The EPA has a good Exposure Factors Handbook, and perhaps this is what the authors mean by data? But I could not determine the distributions used. And I am uncomfortable in assessing whether the authors have properly disentangled uncertainty and intersubject variability. This becomes particularly troubling to me	The uncertainty analysis was performed by the Tennessee Department of Health's (TDOH) contractors, not by ATSDR. For ATSDR's analysis, we used the EPA's Exposure Factors Handbook to select values reflective of lifestyle patterns for people living in the area of study—the southeastern United States. The wording "50th percentile of the 95% confidence interval" has been clarified in the text and represented as the "50th percentile of the uncertainty distribution" as

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	on page 82, lines 8-10, where the authors speak of the 50th percentile of the 95% confidence interval. That is strange wording. Is this 95% interval variability or uncertainty. And a confidence interval does not have a 50th percentile, the underlying distribution from which the confidence interval is constructed has this 50th percentile. The authors need to better describe how variability and uncertainty are being reflected, and how these relate to specific confidence intervals mentioned.	reported in the Task 4 report.
33	I see no description of the pharmacokinetic and dosimetric models used. Are they the ICRP ones? Are they buried inside ChemRisk? EPA has created RadRisk for radionuclides. Why was that system not used?	Please see Section 11. Internal Dosimetry of the *Task 4 of the TDOH's Reports of the Oak Ridge Dose Reconstruction: Radionuclide Releases to the Clinch River from White Oak Creek on the Oak Ridge Reservation—an Assessment of Historical Quantities Released, Off-Site Radiation Doses, and Health Risks (referred to as the "Task 4 report")*. As noted in this section, to calculate doses to people ingesting contaminated drinking water or food, the Task 4 team used the internal dosimetry methodology of the International Commission on Radiological Protection (ICRP) that is based on the ICRP models for bioaccumulation and transfer of radionuclides in the body. This methodology was used to estimate ingestion dose factors and their uncertainty for adults ingesting cesium 137, strontium 90, cobalt 60, and ruthenium 106; for iodine 131, estimates were made for a child up to age 15. Please refer to Section 11 in the Task 4 report for specific details on the internal dosimetry methodology used by the Task 4 team.
34	On page 87 and elsewhere, ingestion doses for water are mentioned. Is treatment of the water assumed? Many water treatment systems will remove radionuclides such as Cs and Sr to some extent.	For past exposures, the Task 4 team evaluated the ingestion of filtered, treated Clinch River water as drinking water. For current exposures to Lower Watts Bar Reservoir surface water, ATSDR evaluated potential exposures to unfiltered surface water via recreational activities and exposure to treated water via municipal waters from household taps. For current exposures to Clinch River surface water, ATSDR evaluated potential exposures to unfiltered surface water via recreational activities. This information has been clarified in the text in the final public health assessment.
35	On page 88, there must be some mention of the exposure duration assumed for external exposures on the shore.	Table 10 in the final public health assessment provides the years of exposure considered for each exposure scenario. As shown in the table, the time period varied by location for external exposures to shoreline sediment. For Jones Island, the years of exposure evaluated were 1963 to 1991. The years of exposure evaluated for external exposures to shoreline sediment at K-25/Grassy Creek, the Kingston Steam Plant, and the City of Kingston were 1944 to 1991. The years of exposure, along with a reference to Table 10, have been added to this section of the final public health assessment.

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36	On page 88, the authors mention (on line 27) an uncertainty analysis. But I can find no details on that, and whether it was a nested variability-uncertainty analysis (which would be appropriate and state-of-the-art).	This refers to a comment made by a technical peer reviewer who was part of a panel of experts ATSDR convened to evaluate the Task 4 report. More details on this uncertainty analysis are not provided in the public health assessment itself, but additional information can be found by accessing the Task 4 report online at http://www2.state.tn.us/health/CEDS/OakRidge/WOak1.pdf.
37	On page 94, tritium is called a "very weak emitter" of radiation. This is not a relevant characterization, since the betas it emits have sufficient range and energy to strike and break DNA bonds. In fact, the RBE of tritium is above 1.	Thank you for your comment. The text was removed from the referenced sentence, which now reads as the following: "The likelihood of adverse health effects from H 3 is extremely low; the concentrations were well below the EPA's current maximum contaminant level (MCL) of 20,000 pCi/L of H 3, an amount that would produce a radiation dose of 4 mrem/year if ingested at 2 liters of water per day for a year."
38	Some ingestion rates are used throughout, but no mention is made of the percentile of the intersubject variability distribution represented by these assumed rates of ingestion. Are these upper percentiles (to be protective)?	To evaluate past, current, and future exposures to radionuclides in Clinch River and Lower Watts Bar Reservoir fish, higher than average fish consumers were evaluated (detailed below). In its Exposure Factors Handbook (available at http://www.epa.gov/ncea/pdfs/efh/front.pdf) that outlines factors commonly used in exposure assessments, EPA recommends for fish consumption using an assumed average intake rate for the general population of 20.1 grams/day (140.7 grams/week) of total fish. Of this fish intake rate, however, only 6.0 grams/day (42 grams/week) is considered as an average intake rate for the general population consuming freshwater and estuarine fish. All of the exposure assumptions used by ATSDR for past, current, and future exposures to radionuclides in Clinch River and Lower Watts Bar Reservoir fish were at least five times **more than** this average intake for the general population eating freshwater and estuarine fish. As detailed below, even when evaluating fish consumption by using assumed intake rates significantly above these recommended assumptions, ATSDR's estimated doses for past, present, and future exposures were below health-based comparison values. In the *Task 4 of the Tennessee Department of Health's Reports of the Oak Ridge Dose Reconstruction (Task 4 report)*, past exposures to radionuclides in Clinch River fish were evaluated for high fish consumers. Reportedly, a maximum fish consumer in the east south central region of the country would eat about 2.4 fish meals per week (based on a 200 gram per meal fish portion) (Rupp et al. 1980. Age dependent values of dietary intake for assessing human exposures to environmental pollutants. Health Physics 39:151-163. Cited in the Task 4 report). The Task 4 report evaluated high fish consumers, who were referred to as "Category I fish consumers" and were described as individuals who frequently ate fish (between 1 and 2.5 fish meals per week). See Table 7.3 in the Task 4 report

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		for more information on the parameters used for fish ingestion rates. Also, the Task 4 report used different ingestion rates to evaluate the water and milk/meat ingestion pathways. See Table 7.2 and Table 7.4 in the Task 4 report for the rates used to evaluate the water and milk/meat ingestion pathways, respectively. ATSDR summarized the Task 4 organ doses for the bone, lower large intestine, red bone marrow, breast, and skin locations using the 50th percentile value of the uncertainty distribution. The 50th percentile (central) values represent the medians of organ doses. To evaluate current and future exposures to radionuclides in Lower Watts Bar Reservoir fish, this public health assessment used data from ATSDR's *Lower Watts Bar Reservoir Health Consultation*. The health consultation used worst-case scenarios to evaluate radiological exposure to fish, assuming adults and children consumed two 8-ounce fish meals per week (454 grams/week). To evaluate exposures via water ingestion at the Lower Watts Bar Reservoir, ATSDR used data from the health consultation that conservatively assumed a worst-case scenario using the maximum concentrations for each radionuclide. ATSDR evaluated exposure to children aged about 10-years-old and assumed they drank and showered with unfiltered reservoir water and swam in the reservoir daily. To evaluate current and future exposures to radionuclides in Clinch River fish, ATSDR assumed a child ate 4 ounces of fish per week (113.4 grams/week) and an adult ate 8 ounces of fish per week (227 grams/week). For evaluating potential exposures for the Clinch River via water ingestion, ATSDR used exposure values from the EPA's *Federal Guidance Report 13*. These values assumed that a swimmer might incidentally ingest surface water at a rate of 0.1 liters per hour while swimming. ATSDR used a swimming frequency of 1 hour per day for 150 days per year as noted in the EPA's *Exposure Factors Handbook*. These values are conservative, and therefore typically overestimate true exposure. Also, to evaluate potential exposures related to current and future goose and turtle consumption, ATSDR used consumption values based on the findings of ATSDR's *Watts Bar Exposure Investigation* of 500 grams of goose liver per year (about 1 pound) and 10 kilograms (about 22 pounds) of goose muscle per year. For turtle consumption, ATSDR estimated doses based on ingesting 100 grams (about 3.5 ounces) of turtle each year. ATSDR conservatively assumed hunters might consume as much as 10 kilograms (about 22 pounds) of goose muscle per year. This amount averages to about one 6 to 8 ounce serving per week or 27 grams/day. Based on fish consumers surveyed during the exposure investigation, the high, average, and low

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		consumption groups consumed about 108, 66.5, and 1.9 grams of fish per day, respectively. Assuming that similar consumption ratios apply to goose consumption, ATSDR calculated that the amount and ratios for a 70-kilogram adult goose consumer would be 27, 17, and 0.5 grams/day, respectively, for high, average, and low consumption groups. If, as assumed for the fish, 10-kilogram children eat one-third the portion sizes that adults eat, their consumption levels would be in the ratios of 9, 5.6, and 0.16 grams/day of goose muscle for high, moderate, and low consumers, respectively. From the exposure investigation, ATSDR learned that average consumers eat about 100 grams of turtle meat a year (0.27 grams/day). High consumers eat turtle meals twice as often as moderate consumers (0.55 g/day), and low consumers eat one-sixth the amount that moderate consumers do (0.05 g/day).
39	On page 107, Table 21, it seems odd to me that the bone and skin ratios for Clinch River (external) divided by background are around 10, and then the ratio for whole body is 60. Bone is representative of the deep dose and skin of the shallow dose, so usually these bracket the ratio for the whole body. But in this case, the whole body ratio is a factor of 6 higher than for either the shallow or deep doses. It may be correct, but it does seem odd to me. The authors should check this.	The variation of ratios is a result of the time weighted averages, the time spent on the shoreline and in the water, and the ingestion and uptake coefficients—each calculated for a specific radionuclide.
40	As a non-regulatory agency, ATSDR keeps a low profile in the public press. Those that are impacted by the Superfund clean up efforts learn of the agency, but the typical citizen has no idea ATSDR exists. Strongly recommend that the introduction be enhanced to give a brief overview to what ATSDR is and how it relates to DHS, CDC, NIOSH, and other similar agencies. I mentioned the CDC and NIOSH only because both make the popular press on a frequent basis and are known to the public.	Additional text describing ATSDR's relationship to the U.S. Department of Health and Human Services (HHS), the Centers for Disease Control and Prevention (CDC), and the National Center for Environmental Health (NCEH) has been added to Section I. Summary on page 1 of the final PHA. Also, Internet links for ATSDR (http://www.atsdr.cdc.gov/) and CDC (http://www.cdc.gov/) have been added as resources for more information about these and affiliated agencies.
41	Reference page 71: One time scope is the period 1988 to present but given the time to publish such a report, present might be defined. Then the past exposure period is 1944 to 1991. The reader gets the impression that the doses for the 3-year period overlap are being double counted. If this overlap is accounted for in any manner, this reader missed it.	The time periods for ATSDR's evaluation of past exposures (1944–1991) and current and future exposures (1988–present and future for Lower Watts Bar Reservoir; 1989–present and future for Clinch River) overlap slightly due to some studies being conducted simultaneously. The doses obtained from these studies are, however, based on different data. Therefore, the estimated past doses do not overlap with the estimated doses for current and future even though the time periods overlap. Text has been added to the final PHA to explain the overlapping time periods. Further, ATSDR's evaluation of future exposures includes exposures occurring after the present time period (2003) evaluated in the PHA.
42	It would be prudent to add statistical uncertainty information to the tabulated	Because of uncertainties regarding exposure conditions and adverse effects

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	dose/hazard data. One result is within a factor of 3 of a CV. What range is this expected to be within: 2.5 or 3.5? Such information would be beneficial to the non-scientific reader.	related to environmental levels of exposure, definitive answers on whether health effects actually will or will not occur are not possible. That said, it is possible for a public health assessment to provide a framework that puts site-specific exposures and the potential for harm in perspective. ATSDR recognizes that uncertainties exist with its dose-based assessments, but using health protective safety factors addresses these uncertainties. ATSDR evaluated the need for an uncertainty analysis as outlined in NCRP Commentary 14 entitled *A Guide for Uncertainty Analysis in Dose and Risk Assessments Related to Environmental Contamination.* In essence, the use of conservative and biased screening calculations indicated the possible resulting dose would be clearly below a regulatory limit. "Conservative screening calculations are designed to provide a risk estimate that is highly unlikely to underestimate the true dose or risk. Therefore, a more detailed analysis will likely demonstrate that the true risk is even less." The document states that screening can be considered among the first steps in conducting an uncertainty analysis as this roughly defines the upper and lower bounds of a distribution of exposed populations or individuals. To use these screening calculations successfully, a decision point has to be determined to establish the boundary at which no further analyses are necessary. According to NCRP Commentary 14, "For example, for dose reconstruction, the National Academy of Sciences has suggested that an individual lifetime dose of 0.07 Sv be used as a decision criterion for establishing the need for more detailed investigation (NAS/NRC 1995)." A value of 0.07 Sv is equivalent to 7 rem or 7,000 mrem—a value that is 40% higher than ATSDR's radiogenic cancer comparison value of 5,000 mrem over 70 years. Thus, ATSDR's screening value is more conservative than the criteria suggested by the National Academy of Sciences as reported by the NCRP. Furthermore, the calculations of other comparison values used by ATSDR in this public health assessment incorporate health-protective safety factors to account for uncertainty, such as human variability and sensitivity of populations.
43	Page 114, line 11: I would replace the word "derived" with "arrived at" or similar wording as the NRC limit was accepted rather than derived.	For clarification, the line being referenced by the peer reviewer does not refer to a U.S. Nuclear Regulatory Commission (NRC) limit. Instead, this line refers to ATSDR's radiogenic comparison value of 5,000 millirem over 70 years that was derived after a review of peer-reviewed literature and other documents developed to review the health effects of ionizing radiation.

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44	Page 123: Of the 2,500 community health concerns logged, what is the basis for the listing of the sample on pages 124–140?	As detailed in the introductory text of Section VI. Community Health Concerns, the community health concerns addressed in this public health assessment are those concerns in ATSDR's Community Health Concerns Database related to issues associated with radionuclide releases from White Oak Creek. These include X-10 facility processes and exposure pathway concerns, concerns about radionuclides associated with X-10's releases to White Oak Creek, concerns about contaminants released from the Oak Ridge Reservation, and general concerns related to the Oak Ridge Reservation.
45	Appendix B, page B-6: The bar graph is clear and informative only if the sentence on line 4, page B-4 is noted. As the initial schedule is no longer being used, recommend that the initial schedule be eliminated and the revised schedule only be shown.	The following sentence was added as a note to the bottom of Figure B-2: "The current Melton Valley closure schedule was accelerated by 9 years to have all closure activities completed by fiscal year 2006." The figure presents both the initial and revised schedule in order to show which closure activities in Melton Valley have been accelerated from the current schedule.
46	I would not change the public health assessment which has been made. This is a group effort from a lot of very competent and interested professionals who have a lot riding on the outcome and who I believe have done a very good job under difficult circumstances.	Thank you for your comment.
47	This document presents ATSDR in a pretty favorable manner. You have done a good job under very difficult circumstances with a lot of unwanted publicity and carping. The science under the report is very good and the report is written in a very good manner that is suitable for both an informed and interested public and the scientific community.	Thank you for your comment.